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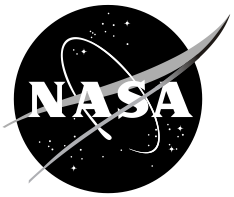

National Aeronautics and
Space Administration

**John C. Stennis Space Center**
**Stennis Space Center, MS 39529-6000**

# John C. Stennis Space Center
# Safety and Health Handbook

## Approval/Concurrence

***Signature on File*** 01/06/2014

Freddie Douglas, Director — Date

Safety and Mission Assurance Directorate

## Document History Log

| Status/Change/ Revision | Change Date | Originator/ Phone | Description |
|---|---|---|---|
| Basic | 10/20/2006 | Glen Liebig 8-2219 | Initial Release. The information in this handbook was derived from SPG 8715.1, which was superseded by SPR 8715.1. |
| A | 10/2007 | B. Newbold 8-3152 | Complete major revision of the SSC Lock Out Tag Out Program affecting pages 39-41 and adding five additional pages along with the addition of an Appendix – Appendix C. The paragraphs affected are 3.10.1, 3.10.1.a, 3.10.1.a.3, 3.10.1.a.4, 3.10.1.a.5, 3.10.1.a.6, 3.10.1.a.7, 3.10.1.a.8, 3.10.1.b, with the additions of 3.10.1.a9, 3.10.1.a10, 3.10.1.a11, 3.10.1.c, 3.10.1.d, 3.10.1.e |
| A-1 | 11/2008 | K. Volante 8-2834 | Grammatical and formatting changes throughout document. Replaced SOLAR with SATERN. Updated referenced documents subsections. Replaced verbiage in Sections 3.5, 3.6, 4.2, 4.4, 4.5, 4.6, 4.7, 4.8, 4.9, and 4.11 with references to new SCWIs covering the specific requirements. 2.3.1(b): added reference to SSC Form 405 and requirement for handling unabated hazards in inspection reports. 2.3.2: added requirement for safety engineer to document hazard. 2.4.3: added (b). 2.6: added requirements for max work time per NPR 3600.1. 2.11: additional requirements for safety critical operations. 3.3: added (x) and (y). 3.4.2: added (g) and (h). 3.15.2: added (c). |

| Status/Change/ Revision | Change Date | Originator/ Phone | Description |
|---|---|---|---|
| | | | 5.4: added statement for developing procedures for combustible gas meter operations. 5.5: added statement for developing procedures for TEAL/TEB. 5.6: added reference to ANSI/AIAA G-095-2004. 5.8: added statement for developing procedures for cryogenic operations. 5.10: added statement for developing procedures for explosive safety.<br>Updated Section 9.1.<br>Deleted appendix for Hazard Assessment and PPE Selection. Deleted appendix for Respiratory Protection Program. |
| B | 10/31/09 | D. Lorance x1516 | Document updated to ensure applicability. SCWIs were created which required the removal of sections that apply to Lockout 3.11, Electrical Safety 3.12, Non-Ionizing Radiation 4.5, Ionizing Radiation 4.4, Hazardous Noise Exposure 4.6, Asbestos 4.7, Hazard Communication 4.8, Blood borne Pathogens 4.9, AED 4.10, Ergonomics 4.11 Smoke Free Workplace 4.12, Process Safety Management 5.10 and Construction Safety and Health 6.0. The Danger Tag system 2.5, was modified to include new criteria and a new tag. The Scaffold section 3.16 (formerly 3.15) was modified to specify current requirements. A reference to a new SCWI was created for Work in Hazardous Classification Areas 3.4 Removed Appendices include: Construction - Appendix B, G, & I, AED - Appendix D, Confined Space – Appendix E, Scaffold – Appendix H. |
| C | 01/13/2011 | A. Rice X 2972 | Updated Explosive Safety Reference. Clarified Worktime Policy in 2.6, Safety Critical Procedures in 2.11, Hot Work 3.13e, and Meter Usage policy in 5.3, Deleted appendix for General Range Safety. SCWIs were created which required the |

| Status/Change/ Revision | Change Date | Originator/ Phone | Description |
|---|---|---|---|
| | | | removal of sections that apply to Lightning protection 3.5, Training and Certification 2.4, SSC Range Safety 2.10. |
| D | 11/01/2012 | A. Rice X 2972 | Updated Section 2.12 to show that system safety SCWI was updated. Updated Section 5.8 to ensure compliance with NASA STD-8719.17. Updated definition of high voltage to be consistent with OSHA definition. |
| E | 11/30/2013 | A. Rice X 2972 | Grammatical error changes. 2.9.6 clarified powered equipment require fire extinguisher. 3.8.C changed distance requirement from 100 ft to 50 ft with exception of Oxygen System. 5.2.3.d.1 changed distance from 100 ft to 50 ft. Updated MSDS to SDS. Added section 2.14 to reference SSC procedure for hazard reporting process. |

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# 1.0 INTRODUCTION

## 1.1 Purpose

All National Aeronautics and Space Administration (NASA) and NASA contractor employees share in the responsibility of:

a. Creating and maintaining a workplace environment free from recognized health and safety hazards
b. Conducting operations in a safe and responsible manner
c. Ensuring full compliance with applicable regulatory requirements
d. Maintaining safety and health excellence that is common to Voluntary Protection Program Star Sites

Fulfilling this responsibility requires a conscious, continued effort to promote safe work practices for all employees at John C. Stennis Space Center (SSC). The success of these health and safety efforts will be reflected in how well these practices are implemented throughout SSC's operations.

## 1.2 Scope

Figures, illustrations, tables, charts, etc., are included in the text of the procedures. Lengthy or more detailed instructional materials and other attachments that supplement the requirements of the procedures are provided in the Appendices.

## 1.3 Applicability

SSC agencies/organizations and their respective contractors are responsible for complying with the procedures and requirements listed herein to the extent specified by their contractual documents.

# 2.0 SAFETY PROGRAM ADMINISTRATIVE REQUIREMENTS AND PROCEDURES

## 2.1 Specific References

a. 14 CFR Parts 1 - 198, Federal Aviation Regulations (FARs)
b. 29 CFR 1910.119, Process Safety Management of Highly Hazardous Chemicals
c. 29 CFR 1960, Basic Program Elements for Federal Employee Occupational Safety and Health Programs and Related Matters
d. 49 CFR 571.500, Low Speed Vehicles
e. NPD 7900.4, NASA Aircraft Operations Management
f. NPR 3600.1, NASA Procedural Requirement Attendance and Leave
g. NPR 7900.3, NASA Procedural Requirement (NPR), Aircraft Operations Management Manual
h. NPR 8715.1, NASA Occupational Safety and Health Programs
i. NPR 8715.3, NASA General Safety Program Requirements

j. NPR 8621.1, NASA Procedural Requirement for Mishap, Reporting, Investigating and Recordkeeping
k. NASA-STD-8719.7, NASA Technical Standard, Facility System Safety Guidebook
l. NASA-STD-8719.12, NASA Standard for Explosives, Propellants, and Pyrotechnics
m. NASA-STD-8719.11, Safety Standard for Fire Protection
n. Title 63, Mississippi Motor Vehicle and Traffic Regulations
o. SPR 8715.1, SSC Safety and Health Program Requirements
p. SPR 1600.1, SSC Security Requirements Handbook
q. SSTD-8070-0007-CONFIG, John C. Stennis Space Center Standard (SSTD) Variance and Alternate Standard Requests
r. SPLN-1200-0003, SSC Safety and Mission Assurance Technical Authority Implementation Plan
s. SPR 8715.7, Range Safety Program
t. SCWI-3410-0003, Training/Certification Plan and Schedule Report
u. SCWI 8700-0001, John C. Stennis Space Center System Safety and Health
v. FAA Form 337, Major Repair and Alteration (Airframe, Power plant, Propeller, or Appliance)
w. MIL-STD-882D, System Safety Program Requirements

**NOTE: Fire Protection Standards at SSC are implemented in accordance with NASA-STD-8719.11, Safety Standard for Fire Protection.**

## 2.2 Center Wide Safety Meetings

### 2.2.1 SSC Safety and Health Council (held quarterly)

a. Responsibilities:
   1. NASA Safety & Mission Assurance (SMA) Directorate - The Safety, Quality and Management Systems Division will serve as the chair of the SSC Safety Management Council. Responsibilities shall include the following:
      a) Choosing a major theme/topic for the meeting
      b) Arranging for guest speakers to be present at the meeting
      c) Facilitating the meeting
   2. Facility Operating Services Contractor (FOSC) - The FOSC is responsible for assisting the current chair of the SSC Safety Management Council in the following:
      a) Notifying concerned parties of the Safety Management Council Meetings
      b) Maintaining an up-to-date list of Council members
      c) Arranging for the meeting room/area in which to host the meeting
      d) Keeping the minutes of the meeting and forwarding copies of the minutes to all concerned parties
      e) Procuring (i.e., preparing the paperwork) for guest speakers and/or special videos to be used during Council meetings

f) Preparing a short synopsis of changes to federal/state regulations in the areas of safety, industrial hygiene/environmental health, radiation protection, transportation safety and of informing the Council

3. Resident Agencies - Resident agencies and their contractors are responsible for designating a representative to attend and participate in the quarterly SSC Safety Management Council meetings.
4. NASA Contractors - The manager of safety for each NASA contractor will attend quarterly Council meetings and provide professional support on an as-needed basis to fulfill the purpose of the meeting.

b. Typical SSC Safety Management Council meeting formats/agenda will include:
   1. Welcoming/Introducing new members
   2. Addressing SSC unique safety problems/concerns
   3. Highlighting unique SSC Safety and Health Operating Procedures
   4. Updating members on recent or near-term changes to federal/state safety and health regulations
   5. Viewing a safety video available for checkout

#### 2.2.2 NASA Safety Awareness Day Meetings (held annually)

Typical formats/agenda for NASA Safety Awareness Day Meetings will include:

a. All Hands - An All Hands meeting will be held for NASA employees and the top-level managers of NASA's contractors involving a short safety program. All individuals are strongly encouraged to attend All Hands meetings.
b. Field Visits - There will be field visits by managers of NASA and NASA contractors of work sites to discuss safety with personnel.
c. Special safety events – There will be various special safety events.

#### 2.2.3 Supervisor/Worker Safety Meetings

a. Supervisor/Worker Safety Meetings shall be held weekly for shop areas or monthly for office areas. Objectives of the meetings are as follows:
   1. Promote safety both on the job and off the job
   2. Supplement instruction and training
   3. Address any new safety concerns arising during the month
b. The time frame of the meeting will vary according to the subject matter, but normally meetings should last 30 to 60 minutes.

### 2.3 OSHA Inspections

a. OSHA Inspections - In the event of an unannounced Occupational Safety and Health Administration (OSHA) inspection, the resident agency, contractor, or SSC employee shall contact the SSC SMA.
b. The SMA Representative will meet the inspector at the South or North Security Area where he/she will verify the credentials and determine the reason for the visit.

c. Once the reason and scope of the inspection has been determined, the SMA Representative shall take action to ensure the proper Agency, contractor, or SCC employees are contacted and an opening conference meeting is held.
d. The SMA Representative shall escort the inspector when the scope of the inspection involves NASA SSC interests. If the inspection involves another agency or contractor, it will be at the discretion of SMA to be included in the inspection or proceed without their participation.
e. SMA will be contacted to participate in the closing meeting held by OSHA at the completion of the inspection.

## 2.4 Safety & Health Training, Education, Certification, and Technical Skills

Instructor-based courses are available through the onsite Facility Operating Services Contract (FOSC) and Test Operations Contractor (TOC). Supplemental training is available through the NASA Safety Training Center (NSTC) and on the Internet through the System for Administration, Training, and Educational Resources for NASA (SATERN) at https://satern.nasa.gov/elms/learner/login.jsp.

SSC safety and health training is available to SSC resident agencies and commercial customers.

Training and Certification Requirements are contained in SCWI-3410-0003, John C Stennis Space Center Training/Certification Plan and Schedule Report.

## 2.5 Danger Tag for Defective/Unsafe Equipment

**IMPORTANT:** This procedure and sample tag DOES NOT apply to the lockout/tagout of hazardous energy/operations during maintenance, rework, and examination. Danger Tag Definition and Use

### 2.5.1 Operational Requirements and Procedures

a. The "DANGER – DO NOT USE" Tag. The DANGER tag, illustrated in Figure 1, will be used by all organizations at SSC. These tags are available from the SSC warehouse.
b. Use - DANGER tags shall be used temporarily on items outside of those placed in designated DO NOT USE locations only and will not be used for purposes other than to identify hazardous or unsafe equipment.
c. Attachment of Danger Tags - DANGER tags can be attached by any employee who discovers a defective or unsafe piece of equipment. Proper care shall be taken when affixing the tag. If the individual is not comfortable with or is uncertain about affixing a tag, he/she shall contact the area supervisor or the cognizant, safety office representative. The tag should be affixed on the equipment so that it is visible to anyone in the area.
d. DANGER – DO NOT USE Tag Notification - In the event a DANGER – DO NOT USE Tag is affixed to a piece of the equipment, the individual who affixed the tag shall immediately notify the affected/responsible supervisor of the finding and action(s) taken.
e. DANGER – DO NOT USE Tag Log - Each responsible manager/supervisor will maintain a DANGER tag log for their assigned area(s) of responsibility. This log will include the date emplaced, exact location, reason, corrective action request (if required corrective action is

not known), expected completion date, and date corrective action was actually completed and tag removed.

f. DANGER – DO NOT USE Tag Visibility - The DANGER tag will be clearly visible and securely affixed to the system, component, tools, equipment, processes, facilities, systems, materials, processes, or tests that are considered defective or unsafe.

g. Defective /Unsafe Conditions - Defective/Unsafe conditions where DANGER tags shall be used to identify a hazardous condition(s) include, but are not limited to the following:
   1. Defective or malfunctioning equipment that would create a physical hazard
   2. Defective tools and power/extension cords
   3. Tools or equipment altered to circumvent the manufacturer-installed safety guards
   4. Chemical and radioactive materials that present hazards
   5. Possible articles involved in mishaps

h. Removal of DANGER Tags - Upon completion of the required corrective action, only the owner supervisor or manager can remove the DANGER Tag. When removing a Tag, the manager or supervisor shall notify the individual who placed the tag if the individual works in the specific area affected. Individuals who work in other departments or areas and would never have exposure to the hazard are not required to be notified.

i. Unauthorized Removal - If a DANGER tag is removed in an unauthorized manner, the cognizant, safety office will investigate to determine the responsibility for such action and will notify proper management for corrective action, including appropriate disciplinary action. This will be documented in a memorandum for record forwarded to the cognizant, safety office as well as the NASA Safety Office.


**Figure 1. Danger Tag.**

## 2.6 Maximum Work-Time Policy

NASA and NASA contractors working at SSC shall abide by maximum allowable work time requirements per NPR 3600.1, NASA Procedural Requirement Attendance and Leave. Work for prolonged hours or for extended periods without adequate time off can contribute to fatigue, which can lead to an unsafe act or condition. Long work hours can negatively impact a person's life away from work, as well as compromise safety and mission success at SSC.

General Requirements:

a. Civil Service and Contractor supervisors shall ensure employee knowledge and enforcements of this policy. Supervisors are also encouraged to ensure that workers are educated on the causes and effects of fatigue.
b. Maximum Shift Lengths - A critical employee should not work in excess of twelve (12) consecutive hours without approval. The hours worked over the individual's standard shift, bringing the total to more than twelve (12) consecutive hours, must be approved by the applicable immediate supervisor or contractor counterpart (or higher).
c. A total of sixteen (16) consecutive hours may be authorized by the applicable director or contractor counterpart (or higher) when a one-time job circumstance exists. The applicable first-level director must approve a variance to this policy, concurred by the Director of SMA, to do so. For worked hours over sixteen (16), the variance must be approved by the Center

Director and concurred by the Director of SMA. When the critical employees are contractors, the same approval process must be followed, with approval and concurrence by the contractor counterparts to the above personnel.

> **Note:** There is the possibility during high rates of overtime that civil service personnel may exceed the Office of Personnel Management (OPM) biweekly pay cut limit (limit on pay for a 2-week pay period). When this is a possibility, the director requesting the overtime variance should also provide a request memo to the Stennis Office of Human Capital (OHC) of the plan for the high overtime periods that lists the affected personnel. It will be signed by the director and by the Director of SMA. OHC can then complete the coordination and authorize the employees to be paid for their worked overtime.

d. Maximum Hours/Working Days - A critical employee must not work in excess of seventy-two (72) hours in six (6) consecutive days, or work more than six (6) consecutive days without one (1) full day off. The approval of the applicable first-level director or contractor counterpart (or higher) will be required for exceptions to this restriction.
e. Rest Time Between Shifts - A minimum of eight (8) hours must be taken off between work shifts.
f. Identification of Critical Jobs and Personnel - Organizations will prepare and maintain a list that identifies and documents critical jobs and critical persons.
g. Extension of Work time - Extension of work time under this policy will be subject to advance written approval. When necessary, oral approval may be obtained, provided it is followed by written verification within one (1) week by the applicable authority. Documented approval will be maintained by the approving organization and will be available to NASA for review.
h. Work time Policy Violations - Violations of this maximum work time policy for critical personnel must be reported immediately to the director of the appropriate primary organization, who will inform the Director of SMA.

## 2.7 Variances from Safety Requirements

This section establishes general requirements for requesting variances or alternate standards for the safety requirements set forth by this manual or by any other NASA/SSC requirement document or procedure.

Under certain circumstances, strict compliance with established safety criteria may unduly delay or prohibit the accomplishment of a task, operation, or test. When it is necessary to deviate from a specific requirement, a written request using SSC Form 517, Variance Request, will be submitted per SSTD-8070-0007-CONFIG, Variance and Alternate Standard Requests. The SMA Technical Authority (TA) process is available for issues the fall under the scope of SPLN-1200-0003, SSC Safety and Mission Assurance Technical Authority Implementation Plan. An additional written request to NASA Headquarters by SMA is required for variances of NASA Headquarters regulations. There are no variances available at the center level for OSHA and other agency regulations.

## 2.8 Imminent Danger Situations

This handbook provides the general safety requirements for stopping operations or practices that, if allowed to continue, could reasonably be expected to result in death or serious physical harm to personnel, to cause major damage to system/facilities, and/or to endanger the ability of SSC to accomplish its mission. These situations are referred to as "imminent danger" situations at SSC.

The following responsibilities and requirements apply:

a. Authority to Stop Work - Anyone has authority to immediately stop unsafe work practices at SSC that can lead to an "imminent danger" situation.
b. Notifications of Operations Stoppage - Any individual who stops an unsafe operation where "imminent danger" is involved will immediately notify the cognizant manager and the cognizant, safety manager for the particular agency, organization, or contractor.
c. Resuming Operations - Operations in which work has been shut down due to an "imminent danger" situation will not resume until corrective actions have been completed and approved by SMA.
d. Defective Equipment Tagging - Any equipment/tools identified as defective and being involved in an "imminent danger" situation shall be tagged in accordance with Section 2.5 "DANGER Tags," in this Handbook.
e. Worker "Safety Time Out" - SSC has adopted a policy of open communication with respect to safety concerns among its employees and its contractors' employees. Any time a safety concern is raised by any employee working on a joint program, the employee has the right to call a "Safety Time Out" to voice his/her concern. Work activities can resume after the parties involved have reached agreement on corrective action or understanding of the situation.
f. Company Safety Policies and Procedures for Work Stoppage - Nothing written in this handbook shall interfere (either directly or implied) with any company's policies/procedures allowing its own employees to stop work activities given their concern for their fellow workers' safety.

## 2.9 Safety of Motor Vehicles and Mechanized Equipment Used on SSC

This procedure provides the general safety requirements for using motor vehicles and mechanized equipment at SSC.

### 2.9.1 General Equipment Requirements

a. Traffic Control Plan - A traffic control plan shall be submitted to NASA SMA for review when work is performed within fifteen (15) feet of a traveled roadway.
b. Removal of Debris - Contractors shall be responsible for removing material such as mud that they tracked onto existing roadways, walkways, etc.
c. Unattended Vehicles - Motor vehicles will not be left unattended while engines are running. The vehicle is considered unattended when the operator is twenty-five (25) feet or more away from the vehicle, which remains in his/her view, or whenever the operator leaves the vehicle and it is not in his view.

d. Motor Vehicle Requirements - Conveyances designed or modified to operate at speeds greater than twenty-five (25) miles per hour must meet all Federal Motor Vehicle Safety Standards that apply to passenger carrying vehicles.
e. Communication Devices - Use of a communication device (e.g., cell phone, radio) by the driver of any vehicle is prohibited unless the vehicle is safely parked or the driver is using a hands-free device. Use of cell phones is prohibited when entering through security gates at SSC.

### 2.9.2 Additional SSC Requirement(s)

a. Inflating and Mounting Tires - A safety tire rack, cage, or equivalent protection shall be provided and used when inflating, mounting, or dismounting tires installed on split rims or on rims equipped with locking rings or similar devices.
b. Working Underneath Heavy Equipment - Before employees are permitted to work under or between heavy equipment, substantially block or crib heavy machinery, equipment, or parts thereof, which are suspended or held aloft by use of slings, hoists, or jacks to prevent falling or shifting.
c. Heavy Equipment Controls - Bulldozer and scraper blades, end-loader buckets, dump bodies, and similar equipment shall be either fully lowered or blocked when being repaired or when not in use. All controls will be left in a neutral position with the motors stopped and brakes set, unless work being performed requires otherwise.
d. Parking Brake - Parking brake shall be set whenever the equipment is parked. Equipment parked on inclines shall have the wheels chocked and the parking brake set.
e. Power Lines - All equipment covered by this part shall comply with the electrical safety requirements of SPR 8715.1, SSC Safety and Health Program Requirements, when working or being moved in the vicinity of power lines or energized transmitters.

### 2.9.3 Specific Motor Vehicles Requirements

a. Employees will not be transported in the bed of pickup trucks without approved seats and seat belts.
b. All equipment/cargo shall be properly secured in place to avoid any movement or shifting while being transported on site.

### 2.9.4 Safety Requirements for All Terrain Vehicles (ATVs)

a. Driver’s License - Operators are to possess a valid driver’s license.
b. Payload Limitation - The manufacturer's recommended payload for ATVs shall not be exceeded. Passengers shall not be carried on ATVs intended for single operator.
c. Number of Wheels - SSC agencies/organizations and their respective contractors shall not use three-wheeled ATVs.
d. Fire Protection - All ATVs shall have a portable fire extinguisher of the proper type mounted on the equipment.
e. Vehicle Signage - ATVs traveling at less than twenty-five (25) mph on public roads will display a standard “SLOW MOVING” vehicle sign.

f. Training Requirements - All NASA and its contractors shall develop training outlines and plans detailing the training that will be accomplished prior to employees utilizing ATVs in the performance of work on SSC.
g. Personal Protective Equipment - All appropriate safety equipment shall be worn when operating an ATV on SSC as outlined in Title 63, Mississippi Motor Vehicle and Traffic Regulations. When work is being accomplished from ATVs on SSC roadways, proper helmet and reflective vest shall be worn.

### 2.9.5 Safety Requirements for Low Speed Vehicles and Golf Carts

a. Golf carts are small utility conveyances that are incapable of exceeding twenty (20) mph. They are only subject to state and local requirements regarding safety equipment for use at SSC. If golf carts are modified from original manufacturer specifications to obtain speeds in excess of 20 mph, they are classified as motor vehicles and must meet federal safety standards. Golf carts are NOT to be used on main SSC public use roads unless they meet all specific Federal Motor Vehicle Safety Standards for motor vehicles. Golf carts operated at night must be equipped with forward and rear lamps.
b. Low speed vehicles are any four-wheeled conveyances with top speed greater than 20 mph but less than twenty-five (25) mph. Low speed vehicles are classified as motor vehicles and must meet specific Federal Motor Vehicle Safety Standards for low speed vehicles (49 CFR 571.500) to operate on SSC roads. Low speed vehicles must be equipped with specified headlamps, stop lamps, turn signal lamps, reflex reflectors, parking brakes, rear view mirrors, windshields, seat belts, and vehicle identification numbers. Low speed vehicles traveling on SSC public roads will display a standard "SLOW MOVING" vehicle sign.
c. Golf Cart and Low Speed Vehicle Safety Procedures:
    1. No golf cart or low speed vehicle is to be operated with more passengers than seating provided.
    2. All occupants of golf carts and low speed vehicles shall keep hands, arms, legs, and feet within the confines of the vehicle at all times when in motion.
d. Operators are to possess a valid driver's license, and use and movement of these type vehicles shall comply with vehicular requirements in SPR 1600.1, SSC Security Requirements Handbook.

### 2.9.6 Material Handling Powered Equipment Requirements

All powered material handling equipment will be equipped with a portable fire extinguisher of the proper type.

### 2.9.7 Site Clearing Equipment

All rider-operated equipment used in site clearing operations shall be equipped with rollover guards.

#### 2.9.8 Rollover Protective Structures

SCC agencies/organizations and their respective contractors shall provide Rollover Protective Structures (ROPS) on all of the following types of material handling and similar equipment:

a. Rubber-tired, self-propelled scrapers
b. Rubber-tired front-end loaders
c. Rubber-tired dozers
d. Wheel-type agricultural and industrial tractors
e. Crawler tractors
f. Crawler-type loaders
g. Motor graders, with or without attachments used in construction work

**Note**: This requirement does not apply to side boom pipe laying tractors.

### 2.10 SSC Range Safety Program

Procedures for SSC Range Safety are contained in SPR 8715.7, John C. Stennis Space Center Range Safety Program.

### 2.11 Safety Critical Procedures

Safety Critical includes any operation, process, or procedure involving materials, equipment, or tasks that have a high potential to result in loss of life, serious injury to personnel, and/or damage to high-value or mission essential systems, equipment, or facilities. These include but are not limited to laboratory operations, high-pressure gas operations in excess of one hundred fifty (150) pounds per square inch gauge (psig), low-pressure high-volume gas operations, voltages above six hundred (600), storage and handling of liquid or solid propellants, storage and handling of explosives, use of "heavy lift" material handling equipment, extreme temperature environments, oxygen-deficient or -enriched environments, permit-required confined space entries, and Lockout/Tagout (LOTO) required operations.

a. The following situations are also classified as Safety Critical procedures:
    1. Experience has shown that the task has a complexity beyond that of routine or requires more than brief training or experience to accomplish.
    2. A task contains steps that must be satisfactorily completed in a specific sequence.
    3. Preparation for the task has been specified as the corrective action by an investigation.
    4. The process is one that must be controlled because the hardware involved, such as flight hardware or test article hardware for which the customer has imposed requirements.
    5. Deviations from Safety Critical procedures shall require the approval of the cognizant, safety representative. Changes occurring during off shifts when safety support is not onsite will be allowed only under the following conditions:
        a) Operating personnel affected by the change are apprised of the change. Safety personnel are notified. The risks associated with the change are discussed in a meeting between the author of the change, safety personnel, and the operating personnel affected by the change.

b) It has been determined in the meeting that the level of risk to operating personnel is not increased.
c) The change is processed as soon as the cognizant, safety representative returns to work.
d) In the event the change is not approved by the cognizant, safety representative, rationale will be provided to the author and operating personnel as to why the change was not approved.

b. The responsible engineer or supervisor shall determine the need for a procedure to address Safety Critical operations (e.g., Detailed Operating Procedures (DOPs); Test Preparation Sheets (TPSs), Problem Reports (PRs), Corrective Action Reports (CARs), Process Plans, etc.).
   1. Preparation of Procedures - The SSC organization performing the work shall write procedures (e.g., DOPs, TPSs, PRs, CARs, Process Plans, etc.) in a manner that provides maximum protection to personnel, precludes procedural error, and minimizes misinterpretation. Procedures shall include steps to:
      a) Ensure the safety of personnel
      b) Specify actions to bring an emergency situation under control
      c) Return the system(s) to the nearest possible safe condition (back-out procedure with the steps to return system to safe condition).
   2. Cautionary Notes - Procedures shall use one of the following cautionary notes to precede specific steps or sections in which a malfunction or error produces a reaction that causes system degradation, personnel injury, or death.
      a) **WARNING** - Maintenance or operating procedures, techniques, restrictions, etc. that may result in severe personnel injury, loss of life, or major equipment damage if not followed exactly.
      b) **CAUTION** - Maintenance or operating procedures, techniques, restrictions, etc. that may result in some damage to equipment or system, or minor injuries to personnel if not followed exactly.
      c) **NOTE** - Maintenance or operating procedures, techniques, restrictions, etc. that require emphasis for safe operation.
   3. Safety Critical Marking - The title page of hazardous procedures (e.g., DOPs, TPSs, PRs, DNCRs, Process Plans, etc.) shall be prominently marked "Safety Critical."
   4. Approvals - All Safety Critical procedures shall require approval from:
      a) the cognizant, safety representative to certify that they have performed a review of the procedures
      b) the cognizant engineer
c. Change Approval - Changes to procedures shall be approved from the cognizant, safety office representative.
d. SSC Variances shall be processed in accordance with John C. Stennis Space Center SSTD-8070-0007-CONFIG, *SSC Variance and Alternate Standard Requests*.

## 2.12 System Safety

### 2.12.1 System Safety General Requirements

**Procedures for SSC System Safety are contained in SCWI-8710-0001, John C. Stennis Space Center System Safety and Health.**

### 2.12.2 System Safety and Risk Assessment Facility Risk Indicator (FRI)

a. Performance of FRI Assessment - The FRI is a first step to estimating the combined level of risk associated with a facility. The FRI assessment classifies the severity of potential hazards inherent to the facility itself; its operations, processes, environment, equipment, potential interfaces, and personnel. Although the FRI can be performed at any time during the Facility Life Cycle, the FRI is generally performed early in the acquisition program during the conceptual phase to ensure potential hazards are identified. The FRI is the initial safety assessment used to help determine the level of system safety effort required to meet NASA safety requirements. This process begins by identifying hazards that may exist at any given point throughout the life of the facility. The FRI evaluation alerts the facility project manager and other acquisition managers of the potential safety concerns within a facility.

b. FRI Scale - The extent to which system safety analysis is applied to facility acquisition is initially based upon the FRI assessment. The FRI process is defined in NASA-STD-8719.7, NASA Technical Standard, Facility System Safety Guidebook. SSC uses unique facility risk indicators ranging from an FRI of 1A (High Risk) to an FRI of 4 (Minimal Risk). These unique indicators are shown in Table 1. An FRI of 1 signifies major risk associated with personnel safety, operational productivity, design effectiveness, environmental impact, and/or other user interfaces. An FRI of 4 indicates negligible or low risk. A review of a checklist in Table 2 assists in determining the FRI for the facility or project, particularly if the Center Safety Department helps with the evaluation.

c. Hazards Evaluation Criteria - The potential hazards inherent to the facility are evaluated using the following criteria as evaluation factors:
   1. Life Safety– Hazard that could potentially cause death or serious injury to personnel
   2. Mission Continuity – Failures that could have serious impact on mission capability and/or operability
   3. Facilities Protection – Failures that could cause serious damage to facilities or equipment resulting in significant financial loss
   4. Environmental Impact – Hazards that could have serious impact to the adjacent facilities or operations or to the surrounding community

**Table 1. Facility Risk Indicator.**

| FRI | Criteria |
|---|---|
| 1A | Facility contains Fuel and Oxidizer, at least one of which is used under ultra-high pressure. |
| 1B | Facility contains Fuel and Oxidizer, at least one of which is used under high pressure. |
| 1C | Facility contains Fuel and Oxidizer, at least one of which is used under medium ultra-high |

| | |
|---|---|
| | pressure. |
| 1D | Facility contains an Oxidizer that is used under ultra-high pressure. |
| 2A | Facility contains Fuel and Oxidizer, but is used only for distribution of those as commodities, or the facility contains explosives or solid propellants. |
| 2B | Facility houses high voltage electrical distribution and switching gear. |
| 2C | Total number of "yes" responses is >38, but does not have any of the criteria called out above for a higher category. |
| 2D | Total number of "yes" responses is >18 and < 38, but does not have any of the criteria called out above for a higher category. |
| 3 | Total number of "yes" responses is >3 and < 18, but does not have any of the criteria called out above for a higher category. |
| 4 | Total number of "yes" responses is >3, but does not have any of the criteria called out above for a higher category. |

**Table 2. Facility Categorization Worksheet NASA Facility Risk Index**

| Facility Protection | | Yes | No |
|---|---|---|---|
| 1) | Is the facility critical to NASA Missions? | | |
| 2) | Are there unique characteristics that must be designed into the facility to accommodate proposed hazardous operations? | | |
| 3) | In the worst-case operational mishap, could the facility, modifications/repair cause $500,000 or more in damage? | | |
| 4) | Is the facility valued at $500,000 or more? | | |
| 5) | Is the facility protected by a fire protection system? | | |
| 6) | Does the facility have pressurized systems >5 psig? | | |
| 7) | Does the facility have pressurized systems >500 psig? | | |
| 8) | Does the facility have pressurized systems >1,000 psig? | | |
| 9) | Does the facility have pressurized systems >5,000 psig? | | |
| 10) | Does the facility have pressurized systems >10,000 psig? | | |
| 11) | Does the facility have mechanical equipment, such as rotating machinery, actuating mechanisms, or other pinch points, that could injure workers? | | |
| 12) | Does the facility have cryogenic materials stored in or around the facility? | | |
| 13) | Does the facility have toxic and/or flammable materials stored in or around the facility? | | |

| | Facility Protection | Yes | No |
|---|---|---|---|
| 14) | Does the facility have explosive or propellant materials stored in or around the facility? | | |
| 15) | Does the facility have radiation hazards present? (magnetic, ionizing, lasers, ultraviolet (UV), radiofrequency, etc.) | | |
| 16) | Does the facility have an electrical substation in close proximity to the facility? | | |
| | **Operational Purpose of the Facility** | | |
| 1) | Are hazardous operations conducted in this facility? | | |
| 2) | Are hazardous chemical or materials stored in this facility? | | |
| 3) | Are hazardous chemical or materials used in this facility? | | |
| 4) | Are the operations conducted in this facility of critical importance to NASA operations and/or mission success? | | |
| 5) | Is there lifting equipment used in the facility? | | |
| 6) | Will unacceptable delays result if the operations of this facility are interrupted? | | |
| 7) | Is the facility a manufacturing facility? | | |
| 8) | Is the facility a test facility? | | |
| 9) | Are there laboratories located in the facility? | | |
| 10) | Do the labs handle toxic and/or flammable materials? | | |
| 11) | Does the facility produce electrical power? | | |
| 12) | Is the power to the facility >50 volts? | | |
| 13) | Is the power to the facility >600 volts? | | |
| 14) | Are there material handling operations occurring in the facility? | | |
| 15) | Does the facility handle cryogenic propellants? | | |
| 16) | Does the facility handle hypergolic propellants? | | |
| 17) | Does the facility have high pressure systems? | | |
| 18) | Does the facility have fuels present? | | |
| 19) | Does the facility have oxidizers present? | | |
| | **Life Safety and Environmental Impact** | | |
| 1) | Can personnel be killed or severely injured as a result of an operational mishap in this facility? | | |
| 2) | Can personnel or the environment be exposed to hazardous materials in the facility? | | |
| 3) | Are personnel involved in hazardous operations in this facility? | | |

| Facility Protection | | Yes | No |
|---|---|---|---|
| 4) | Will any people requiring special considerations (i.e., non-ambulatory disabled, pregnant, etc.) be exposed to potential risk due to an operational mishap? | | |
| 5) | Does the facility have more than one story? | | |
| 6) | Is there limited access to the facility? | | |
| 7) | Is the facility manned during hazardous operations? | | |
| 8) | Are safe havens required to protect personnel in the event of an emergency? | | |
| 9) | Are there areas that have noise levels >80 dBA? | | |
| 10) | Is there machinery that requires guards or other protective measures to prevent personnel from coming in contact with the point of operations? | | |
| 11) | Does the facility have areas that contain stored energy? | | |
| 12) | Does the facility have areas where quantity-distance (QD) requirements apply? | | |
| 13) | Are there facilities that fall within the QD for the facility? | | |
| 14) | Is the facility located inside the QD for another hazardous facility? | | |
| 15) | Does the facility require a chemical hygiene plan? | | |
| 16) | Does the facility have highly hazardous materials, as defined by 29 CFR 1910.119? | | |
| 17) | Are there known uncontrolled hazards in the facility? | | |
| 18) | Are there accepted hazards in the facility? | | |
| 19) | Does any proposed equipment change the risk associated with the facility or personnel? | | |
| 20) | Do any proposed modifications/repairs to the facility change the risk associated with facility or personnel? | | |
| 21) | Do any proposed test articles change the risk associated with the facility or personnel? | | |
| 22) | Were there special requirements for design to limit damage from accidental explosions? | | |

### 2.13 Specific Records and Forms

All records and forms are assumed to be the latest version unless otherwise indicated. Quality Records are identified in the SSC Master Records Index.

a. SSC Form 517, Variance Request
b. SSC Form 602, Request for Physical/Surveillance Examination for Certification
c. SSC Form 727, Employee Certification Card

### 2.14 Hazard Reporting

**2.14.1 Procedures for SSC Hazard Reporting are contained in SCWI-8710-0003, John C. Stennis Space Center Incident Reporting Information System Process.**

## 3.0 INDUSTRIAL SAFETY OPERATING REQUIREMENTS

### 3.1 Specific References

a. 29 CFR 1910, Occupational Safety and Health Standards
b. 29 CFR 1910, Subpart D, Walking-Working Surfaces
c. 29 CFR 1910.253(b)(4)(iii)
d. 29 CFR 1926, Safety and Health Regulations for Construction
e. 29 CFR 1926, Safety and Health Regulations for Construction Subpart L, Scaffolds
f. 29 CFR 1926, Safety and Health Regulations for Construction, Subpart M, Fall Protection
g. 49 CFR parts 171-179 and 14 CFR part 103
h. NFPA (V4) 780, Standard for the Installation of Lightning Protection Systems
i. NFPA 102, Standard for Grandstands, Folding and Telescopic Seating, Tents, and Membrane Structures
j. NASA-STD-8719.17, NASA Requirements for Ground Based Pressure Vessels and Pressurized Systems (PV/S)
k. NASA-STD-8719.11, Safety Standard for Fire Protection
l. SPR 1740.1, Pressure Vessels and Pressurized System Procedural Requirements
m. SCWI-8715-0001, Lightning Warning System
n. SCWI-8715-0002, SSC Personal Protective Equipment
o. SCWI-8715-0003, SSC Fall Protection Program
p. SCWI-8715-0004, Confined Space Entry
q. SCWI-8715-0012, John C. Stennis Space Center Work in Hazardous Classification Areas
r. SCWI-8715-0013, John C. Stennis Space Center Control of Hazardous Energy Control Program.
s. SCWI-8715-0008, Construction Safety and Health Program
t. SCWI-8715-0006, John C. Stennis Space Center Electrical Safety Program.
u. SCWI 8838-0002, John C. Stennis Space Center Hot Work Permit Program Procedure.
v. ANSI B-11 Machine Guarding
w. Compressed Gas Association Pamphlets C-6-1968 and C-8-1962
x. Compressed Gas Association Pamphlet P-1-1965
y. Compressed Gas Association Pamphlets S-1.1-1963 and 1965 addenda and S-1.2-1963
z. Mil-STD-101
aa. NSTM Chapter 550

**NOTE: Fire Protection Standards at SSC are implemented in accordance with NASA-STD-8719.11, Safety Standard for Fire Protection.**

### 3.2 Responsibilities

Managers are responsible for enforcing all Safety and Health Operating Procedures within their assigned areas of responsibility. They must also assure that all physical activity restrictions governing their personnel are applied.

### 3.3 Stennis Space Center Fundamental Safety Rules and Procedures

a. Safe Job Performance - Employees are to ask questions and remove any doubt that may exist regarding the safe way to perform job tasks.
b. Knives - Carrying, transporting, or having on one's person while on SSC property any knife with a blade length of three (3) inches or more is strictly prohibited.
    1. Knives - Only knives necessary for proper performance of one's official duties are authorized, and even then, knives are permitted only in the locations where such duties are performed.
    2. Recreational Equipment - Recreational equipment is exempted while actively engaged in, or while en-route to or from, an approved activity (i.e., fishing).
c. Weapons - Weapons that are prohibited by State or Federal Laws (such as switchblade knives, stiletto knives, shuriken (throwing stars), black jacks, metal knuckles, etc.) shall not be permitted on SSC property.
d. Alterations or Repairs to Safety Equipment - Employees shall not alter or attempt to repair any item of safety or safety-related equipment unless specifically authorized by job classification.
e. Substituting and Improvising - Substitutions or improvising should be minimized and not attempted by technicians without authorization from the responsible engineer. Deviations from written procedures will be approved by the Stand Engineer/Test Director and documented in a timely manner.
f. Makeshift Tools and Shortcut Methods - Locally manufactured tools or shortcut methods shall not be used without written authorization from engineering.
g. Employee Illness - Employees should not work if ill. The illness may cause employees to have an accident and/or injury that harm themselves or others. The employee's doctor should be seen or the employee should report to the SSC Medical Clinic.
h. Blocking or Altering Safety Devices - Safety switches or devices shall not be blocked or altered in any manner.
i. Lifting Heavy or Bulky Objects - Employees must not attempt to lift heavy or bulky objects beyond their capacity. The load should be assessed and help should be obtained when needed. The back should be kept straight, the knees bent, and the lift made with the legs, not the back.
j. Carrying Sharp Objects - Employees must not carry sharp objects without proper covers in pockets.
k. Transport Containers and Devices - Employees shall use approved containers or devices for transporting material or equipment.
l. Paths of Access - Aisles and walkways are to be used at all times. Shortcuts through roped-off areas, across ditches, or over rough ground are prohibited.

m. Cautions and Warnings - All "CAUTION," "WARNING," and "DANGER" signs, sirens, bells, and other safety warnings shall be adhered to at all times.
n. Makeshift Climbing Devices - Makeshift devices (including chairs) shall not be used in place of approved ladders, stands, or lifts for reaching heights.
o. Walking on Roadways - Walking shall be permitted only on the side of the road facing traffic when personnel are walking along roads shared with vehicular traffic.
p. Operation of Machines and Equipment - Machines and equipment shall be operated only by qualified, authorized (certified) personnel.
q. Equipment Test and Inspection - Equipment subject to periodic inspection, test, and/or calibration shall not be used until the inspection, test, or calibration has been accomplished.
r. Use of Air Driven or Electrical Tools - All air or electrically driven machines or tools must be completely stopped and deactivated when leaving the equipment unattended, when it is under inspection, or when changing parts or accessories.
s. Repairing Equipment - Only authorized personnel shall repair electrical or mechanical equipment.
t. Unusable/Damaged Fire Extinguishers - Report unserviceable or damaged fire extinguishers to the Fire Department (ext. 8-3639).
u. Chemical Labeling - Labels shall not be removed from chemical or solvent containers unless the containers are empty and have been thoroughly cleaned. All reused containers must be properly labeled.
v. Skin Cleansing Agents - The use of volatile or flammable chemicals as a skin-cleaning agent is prohibited.
w. Written Safety Procedures - Written operating procedures with safety guidance and sufficient warnings must be prepared, approved, and made available to operators or technicians before production or research and development work is undertaken.
x. Tripping and Blocking Hazards - Avoid flexible cords, hoses, etc. across work floors. Never block routes of exit with cords or hoses. Flexible electrical cords should not be used in place of permanent wiring.
y. Blocking of Fire Lanes - Parking shall be prohibited within fifteen (15) feet of any fire hydrant, fire department connection, or fire suppression systems, or within any fire lane (marked in red). These areas shall also be labeled or marked as no parking zones.
z. Wearing of Jewelry - Because of the snagging hazard, rings should not be worn around moving equipment or operating/construction areas in which personnel have to climb, handle heavy objects, or operate moving machinery. Jewelry must not hang loose to the point where it may be caught. Because of the electrocution hazard, rings and jewelry shall not be worn by personnel working on electrical systems of any voltage level.
aa. Personal Clothing - Clothing shall not hang loose to the point where it may be caught in moving machinery or snag onto dangerous objects (e.g., shirts should be tucked in to the slacks when working around rotating/moving equipment).
    1. Tank tops, net shirts, cut-off shirts, sleeveless shirts, etc. shall not be worn. At a minimum, employees are required to wear a shirt or top that is comparable to a t-shirt with sleeves.

2. Pants shall be full length for activities performed in construction areas and industrial shops. Cutoffs, shorts, and other such apparel are not permitted in these areas.

### 3.4 Work in Hazardous Classification Areas

Procedures for working in Hazardous Classification areas are contained in SCWI-8715-0012, John C. Stennis Space Center Work in Hazardous Classification Areas.

### 3.5 Fundamental Safety Rules and Procedures - Lightning Protection

Lightning Advisories and Warnings shall be issued in accordance with SCWI-8715-0001, John C Stennis Space Center Lightning Warning System.

### 3.6 Fundamental Safety Rules and Procedures - Personal Protective Equipment

Personal Protective Equipment procedures are contained in SCWI-8715-0002, John C. Stennis Space Center Personal Protective Equipment.

### 3.7 Fundamental Safety Rules and Procedures - Fall Protection in Industrial and Construction Activities

Fall Protection Safety Requirements are contained in SCWI-8715-0003, John C. Stennis Space Center Fall Protection Program.

### 3.8 Fundamental Safety Rules and Procedures - Buddy System

This procedure provides the general operating requirements for use of the buddy system to minimize personnel injury and/or limit property damage given an accident or emergency situation.

Buddy System Operations - The “Buddies” are expected to monitor each other, to stay close enough to be able to help in an emergency, to behave safely, and to follow prescribed safety procedures as applicable. The Buddy System shall be used whenever hazardous operations are being conducted. Such operations include but are not limited to:

a. Remote and isolated work operations
b. Operations and maintenance activities of pressure systems
c. Welding/cutting/spark producing operations conducted within fifty (50) feet of propellant, flammable liquid/gas/vapor.
d. Welding/cutting/spark producing operations conducted within one hundred (100) feet of oxygen systems.
e. High voltage (greater than 480 volts) operations
f. Heavy hoisting/lifting operations
g. Marine and rail operations
h. Energized low voltage system operations (i.e., 50 volts or more in which the work has to be performed “hot” and involves working within enclosures or on circuits). Work involving properly de-energized equipment that has been properly locked and tagged out does not necessarily require use of the buddy system unless there is some other requirement for its use
i. Explosive/ordinance/pyrotechnics handling/testing operations
j. Cryogenic transfer and venting operations

k. Confined Space Entries - Confined space entries call for specific requirements of standby personnel. Refer to SCWI 8715-0004.
l. Personnel lift operations
m. Radiological operations
n. Diving operations
o. Excavation Activities - Refer to the Construction Safety and Health Program SCWI-8715-0008 for use of the buddy system when excavations are being made

## 3.9 Safe Use of Powered/Non-powered Handheld Tools at SSC

This procedure provides basic safety guidelines for the use of hand and portable powered tools. It is also intended to assist workers in recognizing the hazards associated with the most common types of tools and the safety precautions necessary to prevent those hazards.

a. Spark Resistant Tools - Employees are required to use only spark-resistant tools made from brass, plastic, aluminum, or wood around flammable substances. Iron and steel hand tools can be a dangerous ignition source.
b. Powder-Actuated Tools:
    1. The tool must not be able to operate until it is pressed against the work surface with a force of at least five (5) pounds greater than the total weight of the tool.
    2. The muzzle end of the tool must have a protective shield or guard centered perpendicularly on the barrel to confine any flying fragments or particles that might otherwise create a hazard when the tool is fired. The tool must be designed so that it will not fire unless this type of safety device is in place.
    3. All powder-actuated tools must be designed for varying powder charges so that the user can select a powder level necessary to do the work without excessive force.
c. Fasteners:
    1. Fasteners must not be driven into materials, such as brick or concrete, any closer than three (3) inches to an edge or corner.
    2. In steel, the fastener must not come any closer than one-half inch from a corner or edge.
    3. Fasteners must not be driven into very hard or brittle materials that might chip or spatter, or might make the fastener ricochet.
    4. An alignment guide must be used when shooting a fastener into an existing hole.

## 3.10 Safety Requirements for Machine/Machinery Guarding

This procedure outlines the basic safety requirements for guarding of machinery and machines used at NASA worksites at SSC. This procedure does not address the safety requirements for using portable handheld tools that are covered in Section 3.9, Safe Use of Powered/Non-powered Handheld Tools at SSC.

### 3.10.1 Machine/Machinery Guarding General Requirements

a. Machine Guards - Removal (or interference) of machine guards and other safety devices for any reason other than necessary maintenance where equipment has been safely locked out is strictly prohibited.

b. Shielded Startup - Startup (i.e., on/off) switches located on industrial shop equipment shall be shielded to prevent accidental startups. A location cannot be used if it is not allowed by OSHA.

#### 3.10.2 Machine/Machinery Guarding Specific Equipment Requirements

a. Aluminum - Aluminum shall be used only on grinders with wheels specifically formulated for use with aluminum.
b. Dressing Tool - A dressing tool shall be used periodically on bench grinders to ensure uniform wear of the grinding wheel throughout the life of the wheel.
c. Drill Presses - of this document depicts the basic safety requirements for drill presses. This should be posted in the immediate vicinity of the drill press, and operating personnel should be trained to the requirements.

#### 3.10.3 Machine/Machinery Guarding General Operational Requirements

a. Qualified Operators - Only fully trained and authorized operators or those under the supervision of a qualified operator will be permitted to operate shop machinery.
b. Unattended Machinery - Operators or maintenance personnel shall not leave running machinery unattended.
c. Thrown Object Protection - Work jigs/fixtures/clamps shall be used to protect the employee from the hazards of thrown objects.
d. Machine guarding shall be designed and maintained in accordance with 29 CFR 1910 Subpart O and American National Standards Institute (ANSI) B-11.

### 3.11 Lockout/Tagout

Instructions for control of hazardous energy are contained in SCWI-8715-0013, John C. Stennis Space Center Control of Hazardous Energy Control Program.

### 3.12 Electrical Safety

Electrical safety requirements are contained in SCWI-8715-0006, John C. Stennis Space Center Electrical Safety Program.

### 3.13 Fundamental Safety Rules and Procedures – General Safety Requirements in Welding/Cutting Operations

This instruction provides the general safety requirements for welding, cutting, and brazing operations at SSC.

a. Hot Work Permits - Welding and/or cutting activities (as well as ancillary grinding operations) shall not be performed outside of designated areas/processes or weld/machine shops unless a Hot Work Permit (SSC Form 68) has been obtained in accordance with SCWI-8838-0002, John C. Stennis Space Center Hot Work Permit Program Procedure. In weld/machine shops, typical industrial safety practices as well as routine safety inspections and shielding will suffice to govern welding activities in these areas.
b. Hazard Analysis - The Area Supervisor shall provide a written hazard analysis of the planned work process to determine the hazards present and to assess the risks associated with the

control measures proposed. The cognizant, safety office will review this assessment and determine the appropriate level of management acceptance for approving the work.

c. Hazardous Work Area Classification - The area in which such work is to be performed will be classified as a hazardous work area and the numbers of personnel within this area will be limited to those actually needed to safely perform the work.
d. Propellant System Configuration - The propellant system will be maintained in a static mode configuration. The amount of material present will be kept to the minimum that system features allow.
e. System Sampling and Leak Prevention - Positive integrity of the system will be maintained to assure that there are **positively** no leaks present. An atmosphere sample (using approved portable gas detectors) shall be taken to verify that there is less than 10% LEL of flammable, combustible, toxic, or hazardous materials in the work area or system. Continuous sampling or periodic sampling will be required if warranted by the process situation or if the work is performed over an extended period of time. Equipment operators must be properly trained and certified (if necessary).
f. Pressure Monitoring and Relief - System pressure relief (venting) will not be performed during the work activities. The system will be monitored by a qualified operator for excessive pressure buildup. In the event that emergency venting is needed, all work activities will be discontinued until the system is returned to a static mode configuration and the work area is rechecked for presence of flammable/combustible/toxic/hazardous materials.
g. Emergency Procedures - Emergency plans will be determined and conveyed to all parties involved/affected with/by the work process.
h. Safety and Fire Equipment - Safety equipment and adequate firefighting equipment/services will be determined and made readily available to the work crews.
i. UV/IR Sensor Shielding - Shields (preferably at the point of welding/cutting operations) shall be used to preclude the inadvertent activation of fire detection systems based on UV and IR sensors.
j. Notifications of Operations - Welding and cutting operations inside buildings/facilities equipped with fire alarms (specifically smoke and fire detectors) will not commence until the FOSC Fire Alarm Technicians have notified the SSC Fire Department and disabled the appropriate detection devices for the given work duration. When fire alarms/detection devices are disabled, the onsite “fire watch” work crew will maintain communications with the SSC Fire Department, and alternate alarm/evacuation notification procedures will be established for the building/facility occupants.

### 3.14 Fundamental Safety Rules and Procedures - General Safety Requirements for Recreational Safety at SSC

This instruction provides the general safety requirements for recreational/promotional activities occurring within the confines of Stennis Space Center. This safety procedure is applicable to all NASA and NASA contractor personnel and their visitors who engage in Stennis Space Center Recreation Center (SSCRC) sponsored activities or other recreational activities approved by NASA management.

### 3.14.1 Recreational Safety Responsibilities

a. Responsible Managers/Supervisors - The responsible supervisor of personnel engaging in recreational activities at SSC shall ensure all:
   1. Employees are familiar with the requirement of this instruction by orientation upon their employment at SSC.
   2. Employees are kept informed of changes to this instruction.

b. NASA/SSC Safety Management Council - Because this procedure affects many different agencies at SSC, the NASA/SSC Safety Management Council shall make all final determinations and clarifications of this procedure to ensure the safety of personnel involved in recreational activities at SSC.

### 3.14.2 Recreational Safety Requirements

a. SSC Designated Walking and Jogging Areas - Recreational walking/jogging is permitted within the boundaries of SSC provided that participants comply with applicable State of Mississippi laws and wear their SSC identification badges.

b. Use of Recreational Facilities – SSCRA Guidelines for Use of SSC Recreational Areas - SSC personnel and visitors will follow the rules for use of SSC recreational facilities established by the SSC Recreation Association (SSCRA). Appendix A of this document provides the rules and general safety requirements for use of the recreational facilities at SSC.

c. Bicycling Safety - Although Mississippi State Law does not require the wearing of a bicycle safety helmet, cyclists are required to wear a helmet while riding at SSC. In addition, all cyclists shall comply with the following guidelines while riding a bicycle within the confines of SSC.
   1. Riders shall abide by all traffic signs/regulations.
   2. Riders shall always ride with the flow of traffic.

d. Use of Tents and Shelters – Fire Safety Inspection - Promotional activities requiring the use of tents and other temporary shelters shall be inspected by the SSC Fire Department to ensure that such tents and structures are in compliance with NFPA 102 prior to their use.

Typically, this inspection will be scheduled in early spring of each year.

## 3.15 Fundamental Safety Rules and Procedures Compressed Gases in Portable Cylinders

NASA/SSC and its contractors shall abide by the requirements outlined in various Compressed Gas Association pamphlets, NASA-STD-8719.17, NASA Requirements for Ground Based Pressure Vessels and Pressurized Systems (PV/S), and SPR 1740.1, Pressure Vessels and Pressurized System Procedural Requirements, for all safety issues regarding the identification, inspection, testing, transportation, handling, use, and storage of compressed gas cylinders. Questions not answered in this section should be directed to the SSC Office of Safety and Mission Assurance.

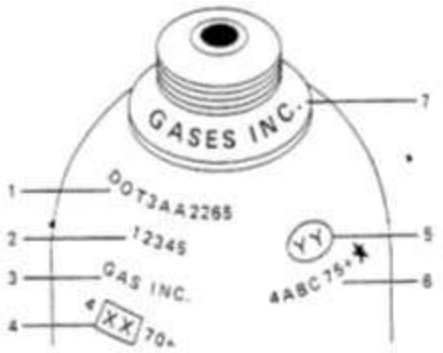
General Requirements for Using Compressed Gases in Portable Cylinders

The use of compressed gases will be in accordance with Department of Transportation (DOT) regulations and recommendations published by the Compressed Gas Association (CGA) that have been incorporated by reference in the Occupational Safety and Health Act.

a. Transporting Compressed Gases in portable cylinders:
    1. Gas cylinders must have the valve protection cover cylinder cap in place while being transported.
    2. Motor vehicles used to haul compressed gas cylinders shall be equipped with racks or other means of securing the cylinders.
    3. Cylinders (or Dewar) containing liquefied or toxic gases shall be transported in vehicles that are not enclosed.
b. Handling Compressed Gases in portable cylinders:
    1. Vehicles must have the hand brakes set and precautions taken to prevent movement of the vehicle during loading and unloading of compressed gas cylinders.
    2. Dollies or specially designed hand trucks (equipped with safety straps or chains) shall be used for the transfer of compressed gas cylinders from loading area to shop or laboratory or other within-building transfer.
    3. Compressed gas cylinders must be securely supported at all times. Cylinders must not be left free-standing at any time; e.g., cylinders unloaded from a truck to a loading dock must be secured until placed on a hand truck for delivery within the building or storage area.
    4. Empty cylinders may contain appreciable residual gas and in any event are likely to cause injury if knocked over; therefore, empty cylinders shall be handled and transported in the same manner as if charged (full).
c. Support Required for Compressed Gases in portable cylinders - Compressed gas cylinders must be supported at all times, whether full or empty. Acceptable methods of support include:
    1. Wall-mounted or bench-mounted gas cylinder brackets
    2. Chains or belts anchored to walls or benches
    3. Free-standing dollies or carts designed for gas cylinders and equipped with safety chains or belts
d. Valve Protective Covers for Compressed Gases in portable cylinders - Gas cylinders must have protection covers in place except when use:
    1. A cylinder connected to a piece of equipment and properly supported is considered to be in use.
    2. The pressure regulators must be removed and valve protection covers replaced before moving cylinders, even though the cylinders are secured to a dolly of hand truck (e.g., acetylene and oxygen cylinders used for cutting, brazing, etc., may not be transported with the regulators attached to the cylinders).
e. Markings on Compressed Gas Cylinders

Compressed gas cylinders are marked with stencils or labels. Generally, the marking is located at the valve end on the cylinder shoulder or sidewall. The exterior of the cylinder is marked

(stamped) or stenciled with Department of Transportation (DOT) identifying marks as shown below per NSTM Chapter 550 and DoD MIL-STD-101.




Notes:
A. Serial number and identifying symbol may be that of purchaser, user, or manufacturer.
B. Markings "5" and "6" are usually shown diametrically opposite other markings on the cylinder neck

1. Cylinder Specification:
   a. DOT – Department of Transportation
   b. 3AA – Specification of type and material of cylinder construction.
   c. 2265 – Service Pressure in psi.
2. 12345 – Cylinder serial number (See Note A)
3. Gas Inc. – Identifying symbol (See Note A)
4. Manufacturing Data:
   a. 4-70 – Date of manufacture and original test date.
   b. XX – Inspector's official mark.
   c. + - Cylinder qualifies for 110% filling.
5. YY – Manufacturer's identifying symbol.
6. Retest Markings:
   a. 4-75 – Data of first 5 year hydrostatic retest
   b. ABC – Re-tester identifying symbol.
   c. + - Cylinder re-qualifies for 110% filling.
   d. * - Cylinder qualifies for 10-year retest interval.
7. Neck ring owner's identification.

**Figure 2. DOT identifying marks required on compressed gas cylinders.**

f. Tube Bank Trailers Requirements:
   1. Tube bank trailers will be subject to the applicable requirements for compressed gas cylinders and the DOT.
   2. Tube bank trailers will be durably marked to indicate contents and operating pressure.

g. General Requirements:
   3. Inspection of compressed gas cylinders - Each employer shall determine that compressed gas cylinders under his/her control are in a safe condition to the extent that can be determined by visual inspection. Visual and other inspections shall be conducted as prescribed in the Hazardous Materials Regulations of the Department of Transportation (49 CFR parts 171-179 and 14 CFR part 103). Where those regulations are not applicable, visual and other inspections shall be conducted in accordance with Compressed Gas Association Pamphlets C-6-1968 and C-8-1962, which are incorporated by reference as specified in 29 CFR 1910.6.
   4. Compressed gases - The in-plant handling, storage, and utilization of all compressed gases in cylinders, portable tanks, rail tank cars, or motor vehicle cargo tanks shall be in accordance with Compressed Gas Association Pamphlet P-1-1965, which is incorporated by reference as specified in 29 CFR 1910.6.
   5. Safety relief devices for compressed gas containers - Compressed gas cylinders, portable tanks, and cargo tanks shall have pressure relief devices installed and maintained in

accordance with Compressed Gas Association Pamphlets S-1.1-1963 and 1965 addenda and S-1.2-1963, which is incorporated by reference as specified in 29 CFR 1910.6.

6. Reserve stocks of cylinders containing flammable gases are not be stored with cylinders containing oxygen. Oxygen cylinders in storage shall be separated from fuel-gas cylinders or combustible materials (especially oil or grease), a minimum distance of 20 feet or by a noncombustible barrier at least five (5) feet high having a fire-resistance rating of at least one-half hour 29 CFR 1910.253(b)(4)(iii).

## 3.16 Scaffold Safety

This instruction provides the general safety requirements for working with all types of scaffolds.

### 3.16.1 Applicability

a. This procedure is applicable to all NASA and NASA contract personnel working with scaffolds at SSC.
b. This procedure is also applicable to all Resident Agencies at SSC and Resident Agency contractors who perform work at SSC.
c. This procedure is applicable to industrial and non-industrial activities and operations, test operations, maintenance processes, and construction projects at SSC.

### 3.16.2 Responsibilities

a. Contractors and Contractor Supervisors shall:
   1. Not allow any employee who has not received specific training to perform any task or activity related to scaffold erection and/or disassembly
   2. Ensure that a competent person is in charge of scaffold erection and use according to the manufacturer's specifications
   3. Ensure that a competent person inspects and verifies appropriate tagging
   4. Ensure that employees are provided with PPE as necessary for their job
b. Competent Person shall:
   1. Oversee the scaffold selection, erection, use, movement, alteration, disassembly, maintenance, and inspection
   2. Be knowledgeable about proper selection, care, and use of the fall protection equipment
   3. Assess hazards by completing a thorough inspection at the beginning of every shift and apply the appropriate tag to that scaffold prior to use
c. Employees shall:
   1. Comply with all applicable guidelines contained in this procedure. Employees will report damaged scaffolds, accessories, and missing or lost components
   2. Assist with inspections as requested. Employees will NOT use any scaffold that either is not tagged or is tagged with the “DANGER” tag
   3. Verify the scaffold tag prior to use
d. Cognizant Safety Office shall:
   1. Develop and implement the training for Competent Persons
   2. Develop and implement basic hazard familiarization or user training for all scaffold users

3. Make periodic inspections of any worksite or shop that utilizes scaffolds to verify compliance with this procedure

### 3.16.3 General Safety Requirements

a. All scaffolds shall be designed by a Qualified Person or manufacturer and shall be erected, loaded, and used in accordance with that design or with manufacturers' specifications.
b. All scaffolds erected and used at SSC, at a minimum, shall be compliant with subpart D of the 29 CFR 1910 and with subpart L of the 29 CFR 1926.
c. In cases of conflicting statements between the manufacturer's specifications and the OSHA Standards, the scaffold erector/user shall follow the more stringent of the conflicting statements.
d. Scaffold types outlined within 29 CFR 1926, subpart L, may be used at SSC. Other types of scaffolding not included in that standard may be approved for use by the Cognizant Safety Office, provided the design is approved by a Registered Professional Engineer.
e. Scaffolds shall be erected, altered, moved, disassembled, or used only under the direct supervision of a competent person.
f. All employees who perform work on scaffolds shall be trained by a competent person to recognize the hazards associated with the type of scaffold being used and to understand the procedure to control or minimize those hazards.

### 3.16.4 Fall Protection

Fall Protection Safety Requirements are contained in SCWI-8715-0003, John C. Stennis Space Center Fall Protection Program.

### 3.16.5 Inspections

a. Pre-use Inspection - A qualified field engineer must inspect scaffolds before initial use. If a scaffold is to be used for an extended period of time, the scaffold shall be inspected periodically in addition to the pre-use inspection. It is recommended the field engineer use the SSC Scaffolding Inspection tool in Appendix C the specific scaffolding type in use.
b. Scaffold users requiring a pre-use inspection shall submit an advanced notification to the responsible field engineer. This notification must be made at least 48 hours prior to the intended use.
c. Daily Inspection - Prior to each shift, scaffolding shall be inspected and tagged by a designated scaffold competent person with an inspection tag indicating that the scaffold is approved for employee use. Any untagged scaffold shall NOT be used.

### 3.16.6 Tagging Requirements

a. All scaffolds erected at SSC are required to be tagged with appropriate erectors/inspectors tag. The tag(s) will state the status of the scaffold and whether it is safe for use. Three different tags will be used to identify the safety status of the scaffold:
b. A complete scaffold GREEN TAG (Figure 3) will be attached to any scaffold that was built to meet OSHA and SSC standards and is safe for all crafts to work from. This tag will be

signed by the competent person who was in charge of erecting the scaffold and will be placed in a conspicuous location near the scaffold access point after the scaffold has been inspected prior to its use.

c. For any scaffold with platform(s) that physically cannot be completely erected (i.e., interference with equipment prevents installation of all guardrails or planks), a caution YELLOW TAG (Figure 4) will be attached to the scaffold. This tag will indicate that the scaffold has been inspected and may be used only by employees wearing a properly anchored personnel fall arrest system, including a full body harness and lanyard. This tag will be signed by the competent person who was in charge of erecting or inspecting the scaffold and will be placed in a conspicuous location near the scaffold access point after the scaffold has been inspected prior to its use.

   **TAG USAGE NOTE:** Use of Yellow Tag(s) does not permit intentional erection of incomplete scaffolds. In no case shall a scaffold that is missing members required for structural stability (i.e., bearers, runners, posts, or braces) be tagged with yellow or green scaffold tag(s).

d. If any condition exists that would render the scaffold unsafe or in need of repair due to incomplete construction or damage, the scaffold shall be tagged with a red and white DANGER TAG. Any person who finds the unsafe condition shall be authorized to place the Danger Tag. The use of Danger Tags at SSC shall be in accordance with section 2.5 (Danger Tag) of this Handbook and shall be placed in a conspicuous location near the scaffold access point.

e. All suspended scaffolds will be tagged in two locations prior to use, indicating that a thorough inspection has been completed. One tag will be conspicuously displayed at the scaffold platform, documenting the inspection of the platform components. The second tag will be displayed on an outrigger beam or anchor point located on the roof or connection point of the structure being worked, documenting the inspection of the suspension, rigging, and counterweight hardware.

f. During the erection and/or disassembly of scaffolds, the competent person shall place a DANGER TAG on the scaffold, indicating the scaffold is not safe to use. Once erection and/or disassembly is complete, the appropriate yellow or green tag will replace the danger tag.

   **SCAFFOLD CONFIGURATION NOTE:** Under no circumstance should a scaffold be reconfigured or altered by unqualified personnel. Qualified scaffold erectors under the supervision of a competent person are the only personnel who can reconfigure or alter a scaffold at SSC. A competent person as defined by OSHA is one who is capable of identifying existing and predictable hazards in the surroundings or working conditions that are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

**Figure 3. Green Scaffold Tag.**


Green Scaffold Tags can be obtained from the SSC Warehouse

**Figure 4. Yellow Scaffold Tags.**


Yellow Scaffold Tags can be obtained from the SSC Warehouse

### 3.16.7 Training

a. Each NASA Contactor at SSC shall provide training for their employees who (1) perform work while on scaffolds, (2) are involved in erecting, disassembling, moving, operating, repairing, maintaining, or inspecting scaffolds and, (3) have lost the requisite proficiency. Listed below are items that are required to be covered in the training program.
   1. Scaffold Users - Employees who perform work on scaffolds will be trained by a competent person to recognize the hazards associated with the type of scaffold being used and to understand the procedures to control or minimize those hazards. The training will include the following topics as applicable:
      a) The nature of any electrical hazards associated with scaffold use.
      b) The nature of and the correct procedures for erecting, maintaining, and disassembling the fall protection and falling object protection systems used.
      c) The proper use and limitations of the scaffold and the proper handling of materials on the scaffold.
      d) The proper use of fall protection and conditions under which personal fall arrest is required.
      e) The maximum intended load and the load-carrying capacities of the scaffolds used.
      f) The SSC scaffold tagging requirements (GREEN, YELLOW, and DANGER).
      g) Any other pertinent requirements of the OSHA and SSC standards.
   2. Scaffold Erectors/Disassemblers - All employees who erect, disassemble, move, operate, repair, maintain, or inspect scaffolds will be trained by a competent person to recognize the hazards associated with the work being done. The training will include the following topics as applicable:
      a) The nature of scaffold hazards.
      b) The correct procedures for erecting, disassembling, moving, operating, repairing, inspecting, and maintaining the specific type of scaffold.
      c) The design criteria, maximum intended load-carrying capacity, and intended use of the scaffold.
      d) The SSC scaffold tagging requirements (GREEN, YELLOW, and DANGER).
      e) Any other pertinent requirements of 29 CFR 1926, subpart L (Scaffolds).
      f) Any other pertinent requirements of 29 CFR 1926, subpart M (Fall Protection).
   3. Retraining - When there is reason to believe that an employee lacks the skill or understanding needed for safe work involving the erection, use, or dismantling of scaffolds, the employee shall be retrained so that the requisite proficiency is regained. Retraining shall be performed when the following situations exist:
      a) Where changes at the worksite present a hazard about which the employee has not been previously trained.
      b) Where changes in the types of scaffolds, fall protection, falling object protection, or other equipment present a hazard about which an employee has not been previously trained.
      c) Where inadequacies in an affected employee's work involving scaffolds indicate that the employee has not retained the requisite proficiency.

b. Contractors are responsible for obtaining training for their personnel and ensuring all subcontractors have met OSHA and NASA training requirements. NASA employees who are required to use scaffold during the course of their duties shall, at a minimum, attend the FOSC "Scaffold User Training".
c. Managers and/or supervisors shall maintain current training records as well as training requirements for each employee tasked with duties associated with scaffolds.
d. Training records shall be documented in writing.
e. Construction contractors who will who erect, disassemble, move, operate, repair, maintain, inspect, or use scaffolds at SSC must provide training qualifications of personnel involved in those activities and shall submit these training certifications to NASA SMA with their safety and health plan.

### 3.17 Specific Records and Forms

All records and forms are assumed to be the latest version unless otherwise indicated. Quality Records are identified in the SSC Master Records Index.
a. SSC Form 68, Hot Work Permit

## 4.0 INDUSTRIAL HEALTH PROGRAM ADMINISTRATIVE REQUIREMENTS AND PROCEDURES

### 4.1 Specific References

a. 29 CFR 1910.134, Respiratory Protection
b. 29 CFR 1910.1450, Occupational Exposure to Hazardous Chemicals in Laboratories
c. 29 CFR 1910.95, Occupational Noise Exposure
d. SPD 1800.1, Smoke-Free Workplace.
e. SCWI-1800-0001, Ergonomics Program
f. SCWI-1800-0002, SSC Hearing Conservation
g. SCWI-1800-0003, SSC Blood borne Pathogens Control Program
h. SCWI-8715-0015, Laboratory Chemical Safety and Health Program
i. SCWI-1800-0005, John C. Stennis Space Center Hazard Communications
j. SCWI-8500-0004-ENV, John C. Stennis Space Center Hazardous Materials, Hazardous Waste and Solid Waste Procedures and Guidelines
k. SCWI-8500-0019-ENV, Asbestos Hazard Control Plan
l. SCWI-8700-0002, Health Physics Program
m. SCWI-8715-0002, John C. Stennis Space Center Personal Protection Program
n. SCWI-8838-0001, John C. Stennis Space Center Automated External Defibrillator (AED) Protocol Program
o. ANSI Z136.1, Safe Use of Lasers

### 4.2 Respiratory Protection Program

Respiratory Protection Program procedures are contained in SCWI-8715-0002, John C. Stennis Space Center Personal Protection Program.

### 4.3 Laboratory Chemical Safety and Health Program Protection Program

The Laboratory Chemical Safety and Health Program procedures are contained in SCWI-8715-0015, John C. Stennis Space Center Laboratory Chemical Safety and Health Program.

### 4.4 Ionizing Radiation Protection

Ionizing Radiation Protection procedures are contained in SCWI-8700-0002, John C. Stennis Space Center Health Physics Program.

### 4.5 Non-Ionizing Radiation

Non-Ionizing Radiation Protection procedures are contained in SCWI-8700-0002, John C. Stennis Space Center Health Physics Program.

### 4.6 Safety and Health Requirements for Hazardous Noise Exposures

Hazardous Noise Exposure safety requirements are contained in SCWI-1800-0002, John C. Stennis Space Center Hearing Conservation.

### 4.7 Safety and Health Requirements for Asbestos Management and Awareness

Asbestos Management procedures are contained in SCWI-8500-0019-ENV, John C. Stennis Space Center Asbestos Hazard Control Plan.

### 4.8 Chemicals/Hazardous Materials Safety

Chemical/Hazardous Material Safety procedures are contained in SCWI-1800-0005, John C. Stennis Space Center Hazard Communications.

### 4.9 Blood Borne Pathogen Health Program

Blood Borne pathogen procedures are contained in SCWI-1800-0003, John C. Stennis Space Center Blood borne Pathogens Control Program.

### 4.10 Automated External Defibrillator Program

External defibrillator procedures are contained in SCWI-8838-0001, John C. Stennis Space Center Automated External Defibrillator (AED) Protocol Program.

### 4.11 Ergonomics Program

Ergonomic procedures are contained in SCWI-1800-0001, John C. Stennis Space Center Ergonomics Program.

### 4.12 Smoke-Free Workplace

Smoke-Free Workplace procedures are contained in SPD-1800.1 (Specific Records and Forms).

All records and forms are assumed to be the latest version unless otherwise indicated. Quality Records are identified in the SSC Master Records Index.

## 5.0 HAZARDS SAFETY AND HEALTH OPERATING PROCEDURES

### 5.1 Specific References

a. 29 CFR 1910.119, Process Safety Management of Highly Hazardous Chemicals
b. 29 CFR 1910.145, Specifications for Accident Prevention Signs and Tags
c. 29 CFR 1910.146, Permit-Required Confined Spaces
d. 29 CFR 1910.1000, Air Contaminants
e. NPD 8710.5, NASA Safety Policy for Pressure Vessels and Pressurized Systems
f. NASA-STD-8719.9, Standard for Lifting Devices and Equipment
g. NASA-STD-8719.17, NASA Requirements for Ground Based Pressure Vessels and Pressurized Systems (PV/S)
h. NASA-STD-8719.11, Safety Standard for Fire Protection
i. SPR 8500.2, John C. Stennis Space Center Environmental Operations and Implementation Program Procedural Requirements
j. SSTD 8070-0089-FLUIDS, Surface Cleanliness Requirements for SSC Fluid Systems
k. SSTD-8070-0097-TEST
l. SSC-66-200, SSC Standard for Bourdon Tube Pressure and Vacuum Gages for Use in Facility Piping or Tubing Systems
m. SCWI-8715-0010, John C. Stennis Space Center Process Safety Management (PSM) program
n. SWI-8834-0001, SSC Lifting Devices and Equipment Management Plan
o. ACGIH: TLVs For Chemical Substances and BEIs
p. AMCR 385-100, Army Material Command, Safety Manual, latest edition
q. ANSI/AIAA G-095-2004, Guide to Safety of Hydrogen and Hydrogen Systems
r. ASTM Manual 36, Manual for Safe Use of Oxygen and Oxygen Systems: Guidelines for Oxygen System Design, Materials Selection, Operation, Storage, and Transportation
s. DOT Code of Federal Regulations, Title 49
t. Hydrogen Peroxide Rocket Manual (1965) published by FMC Corporation, authored by James C. McCormick, copyright FMC

**NOTE: Fire Protection Standards at SSC are implemented in accordance with NASA-STD-8719.11, Safety Standard for Fire Protection.**

### 5.2 General Hydrogen Line Breaking

This procedure provides the general operating requirements for preparation of lines (pipes and tubes), accumulators, vessels, etc. that have contained hydrogen ($H_2$) or are suspected to have contained $H_2$ for safe entry (opening or breaking into the system). This procedure does not address the removal of liquid hydrogen from vessels or lines. This document addresses those systems in which hydrogen existed in a gaseous form or those liquid hydrogen systems that have been emptied of liquid or warmed to the point that the liquid has become gaseous.

#### 5.2.1 Responsibilities

a. Engineer - The responsible engineer (i.e., test, construction, project, etc.) shall determine the method of inerting the system containing hydrogen. The engineer will also ensure that applicable safety requirements (e.g., aspects of this and other safety procedures, safety requirements unique to the system being worked on, etc.) are incorporated into applicable operational procedures/checklists (e.g., Engineering Work Requests (EWRs), DOPs, TPSs, etc.). The engineer shall ensure that applicable procedures/checklists are labeled Safety Critical as called for in Safety Critical Procedures in Section 2.11 of this document for any activity/operation that requires breaking/entering into hydrogen systems.
b. Safety Representative - The cognizant safety representative will review and approve the applicable procedure and provide support to these activities/operations as needed.
c. Supervisors/Managers - Supervisors/managers are responsible for ensuring that those personnel required to break/enter hydrogen systems are trained in this procedure and appraised of the hazards associated with the breaking/entering of the specific hydrogen system being worked on.
d. Employees - Employees shall follow prepared procedures when breaking/entering hydrogen systems.

#### 5.2.2 General Entry Requirements

**WARNING: Prior to beginning work on a system that is suspected of containing or known to have contained hydrogen atmosphere workers must make that system inert.**

The general order of events for hydrogen system entry and reactivation of hydrogen systems follows:

a. Pre-Entry Ambient Temperature - Prior to entry, bring all systems to ambient temperature to ensure the system contains gas and not liquid.
b. Insertion of Inert Gas - Insert all systems with an inert gas, followed by verification that the system is inert. Methods of inertion are described in this document (Section 5.2.4). Verification is accomplished by sampling (using an approved and calibrated tester or by lab analysis).
c. System Entry - Break into the system and perform the work as required.
d. System Closure - Close the system and leak check all disturbed joints with an inert gas.

   **NOTE:** Helium is preferred inert gas.

e. Re-inerting System - Remove any atmospheric air from the system via inerting the system with an inert gas.
f. System Purification - Purify the system with hydrogen gas to remove the inert gas if required. On the first hydrogen cycle, test the system for hydrogen at all disturbed joints. To ensure meeting purification levels, take samples and verify them by laboratory analysis.
g. Reactivation - Reactivate the system and perform required functional checkouts.

### 5.2.3 General Safety Requirements

a. Safe Hydrogen Concentration - The hydrogen concentration must be less than 0.8% (20% LEL) by volume to be considered safe for system entry.
b. Purge Gas Depressurization Sampling - Conduct sampling during the final depressurizing of the purge gas before opening of the system. Take an additional sample at the point of entry on every opening/re-opening of the system.
c. Continuous Monitoring - Systems not disconnected from active hydrogen systems require continuous monitoring with an electronic type $H_2$ tester.
d. Adherence to Basic Safety Guidelines - Whenever working on or in the proximity of hydrogen systems, comply with the following guidelines:
    1. Eliminate all sources of ignition (such as smoking, welding, burning, grinding, open electrical outlets, heat producing equipment, heat guns, etc.) within fifty (50) feet of the intended operation.
    2. All personnel performing tasks on hydrogen systems should, as a minimum, wear flame retardant coveralls.
e. Pre-Entry $GH_2$ Sampling - Systems entry delayed for thirty (30) minutes or more after completion of the inertion sampling of the system for gaseous hydrogen ($GH_2$) content below acceptable levels will be repeated just prior to entry.

### 5.2.4 Specific Purging/Inerting/Purification Methods

a. Pressure-Purge Inerting:
    1. Vent the system to 2-3 psig if the system is at a higher pressure.
    2. Pressurize the system to a chosen pressure with helium or gaseous nitrogen. This pressure depends on the type of system and determines the number of cycles required. The pressure should be held as long as possible, preferably for thirty (30) minutes.
    3. Repeat steps a.1 and a.2. Calculate the number of cycles necessary to obtain the maximum allowable concentrations of hydrogen using formulas.

**EXAMPLE: (CALCULATION USING FORMULAS)**

Assume the initial pressure is 3 psig [17.7 pounds per square inch absolute (psia)] hydrogen.
Assume a purge pressure of 38.4 psig (53.1 psia).
(**Note:** The average ambient pressure at SSC is 14.7 psia.)
The expression to calculate the number of cycles is:

$$\left(\frac{Pmin}{Pmax}\right)^n \left(\frac{GH_2}{Inert}\right) = Ratio$$

Where: n = Number of cycles
Pmin = Minimum pressure of Cycle, psia
Pmax = Hydrogen gas to inert gas
Calculation:
Assuming 0.8% by volume hydrogen is required for tank entry.

$$\left(\frac{Pmin}{Pmax}\right)^n \left(\frac{GH_2}{Inert}\right) = Ratio$$

$$\left(\frac{17.1}{53.1}\right)^n = (.00800)$$

n = 4.4 or 5 cycles required

b. Evacuation-Purge Inerting:

**WARNING: If the system is suspected to have leakage, evacuation-purge inerting should not be used because the first evacuation could suck air into the hydrogen system, resulting in a contained explosive mixture.**

1. Evacuate the system as low as possible, preferably to less than 1.5 psia.
2. Break the vacuum with helium or gaseous nitrogen and pressurize the system. The purge pressure depends on the type of system and influences the number of cycles required. Hold the pressure for as long as possible (preferably for thirty (30) minutes).
3. Repeat steps b.1 and b.2. The number of cycles necessary to obtain the maximum allowable concentrations of hydrogen can be calculated.

WARNING: This method is quite effective since a higher-pressure differential can be achieved; however, the external pressure of the vessel must be known since there is a danger of implosion.

c. Flowing-Purge Inerting - This is the simplest but least satisfactory method of inerting because it provides no positive assurance that a completely inert atmosphere has been attained. This method requires the use of an inert purge (gaseous nitrogen ($GN_2$) or helium (He)) flowing into one part of the system and flowing out another part of the system. Since most systems contain traps where hydrogen may not be adequately removed by a flowing purge, use this method only where other methods cannot be used. Purging configurations should ensure turbulent flow of the purging gas, and flow rates should ensure that all parts of the system can be thoroughly purged.

Use the following analysis methodology to determine the length of time to flow the purge. Or determine the length of time to flow the purge by using the following analysis methodology.

Step 1. Determine the standard cubic feet in the line or system to be purged.
Step 2. Determine the standard cubic feet needed to bring the line to safe limits based on calculations.
Step 3. Determine the number of standard cubic feet per minute that can be flowed through the system within the existing system parameters.
Step 4. Apply a safety factor of two (2) or three (3) to the flow duration to reduce the possibility of trapped hydrogen.

d. Purification Process - Verify that the system's purity levels are within acceptable levels of the specified service fluid prior to introducing the service fluid. Use either the pressure-purge

inertion method (Section 5.2.4(a)) or the evacuation-purge inertion method (Section 5.2.4(b)) to aid in the purification process to reduce the residual gas levels to the level desired. The number of purge cycles can be calculated or estimated by use of the attached chart. If absolute verification of the residual gas levels is required, then laboratory analysis must be utilized!

## 5.3 Oxygen and Combustible Gas Meter Operations

NASA/SSC and its contractors shall develop and adhere to procedures regarding the safety training and authorization required to operate oxygen, toxic atmosphere, and/or combustible/flammable gas meters. The following procedure identifies the training and authorization required to operate oxygen, toxic atmosphere, and/or combustible/flammable gas meters for ensuring a safe atmosphere for work.

### 5.3.1 Responsibilities

a. Safety Offices - The individual Safety Offices are responsible for providing training and certifications in the use of oxygen ($O_2$), toxic atmosphere and of combustible gas meters for their personnel. Each office shall also provide support to their personnel in developing safe procedures for work involving sampling of hazardous atmospheres and/or confined space entry.
b. Safety Representatives - The safety representative will review and approve purchase requests for $O_2$, toxic atmosphere and combustible gas meters.
c. Supervisors/Managers - Supervisors/Managers are responsible for ensuring that personnel required to work in areas where air contamination is a concern or required to work in confined spaces have been trained and authorized in the use of the $O_2$, toxic atmosphere and combustible gas meters.

### 5.3.2 General Safety Requirements

Safe work atmosphere boundaries for combustible/flammable gases will be established by using gas meters as follows.

Combustible gas meters indicate the percent by volume of the LEL of the gas sampled. For example, the explosive limit for hydrogen gas is approximately 4%-75% hydrogen in air. (See Notes 1 and 2 below.) The LEL for hydrogen is 4% (4% hydrogen is the lower explosive limit in air). The combustible gas meter indicates a percent of this LEL as indicated in Table 6.

**Table 3. Percent of LEL.**

| Percent Hydrogen in Air | Percent LEL |
|---|---|
| 1% | 25% |
| 2% | 50% |
| 3% | 75% |
| 4% | 100% |

Calibrate the combustible gas meter to near zero (0) in open air (no combustible gases present). When an atmosphere is sampled, any LEL readings above ten percent (10%) may indicate a combustible gas contamination problem.

**NOTE 1:** The LEL for other combustible/ flammable gases/vapors will differ from hydrogen and must be determined prior to using the meter.
**NOTE 2:** The instrument must also be evaluated to determine its ability to measure the particular gas/vapor.

#### 5.3.3 Safety Requirements

a. Atmospheric Sampling Training and Authorization - Each respective safety office will provide training and authorization to perform atmospheric sampling that will be valid for a period not to exceed five (5) years.
b. Notification, Review, and Approval - All work requiring entry into confined spaces are considered Safety Critical and require notification and review/approval of work documents by the respective safety office.

#### 5.3.4 Safety Requirements for Specific $O_2$/Toxic Atmosphere/Combustible Gas Meters

Calibration Requirements - The following calibration requirements are applicable to all personnel who use the identified meters:

a. Use manufacturers' guidance/recommendations to determine the equipment schedule of laboratory/factory calibration checks. Oxygen/combustible gas meters will be laboratory calibrated, as a minimum, once every six (6) months. Personnel will not use meters for which the calibration has expired.
b. Personnel using a combustible gas meter shall determine whether the meter is calibrated to the gas/vapor being checked.

   METER CALIBRATION NOTE: Most of the portable combustible gas detection instruments in use at NASA/SSC are calibrated for hydrogen. Petro-chemical industry instruments are usually calibrated with pentane, and calibration with methane is required for below-ground work (excavation/utilities).

c. Perform a daily bump check of the instrument with a known calibration gas before each day's use prior to the use of $O_2$/combustible gas meters in confined space environments.
d. Perform a daily bump check of the meter with a known calibration gas before each day's use prior to using a toxic gas meter in a potential toxic environment.

### 5.4 Safe Handling of Triethylaluminum/Triethylborane

NASA/SSC and its contractors shall develop and adhere to safety requirements that list the hazards involved, safety equipment required, safety precautions to follow, and procedures/process requirements when working around Triethylaluminum (TEAL) and/or Triethylborane (TEB). The following procedure outlines the hazards involved, safety equipment required, safety precautions to be observed, and procedures/process requirements when working around TEAL or TEAL/TEB. TEAL and TEAL/TEB are used interchangeably through this

section. The same procedures apply to both. Always ensure that a recent Safety Data Sheet (SDS) is readily available and is reviewed.

### 5.4.1 General Safety Requirements

a. Basic Safety Requirements:
   1. All areas of operation where TEAL/TEB is used, handled, transferred, or stored are considered hazardous and will be classified as Safety Critical, requiring the preparation of written operational procedures.
   2. Perform all operations involving the use, handling, or transfer of TEAL/TEB using the minimum number of personnel required to perform the task while still incorporating the buddy system to conduct the tasks.
   3. Welding or using a cutting torch on or near any containers or piping systems used for TEAL/TEB, even when empty, is prohibited.
   4. Personnel working with TEAL/TEB or TEAL/TEB systems shall wear PPE when there is any possibility of exposure. See section 5.4.1.a.9 for requirements.
   5. All TEAL/TEB handling, transfer, or storage sites require emergency eye wash stations and safety showers. The eye washes/safety showers shall be operational and located in close proximity to operations.
   6. TEAL/TEB will never be mixed with any other chemical substance/compound unless a thorough investigation has shown the materials are compatible or the resulting reaction is controllable from a design aspect.
   7. Clean equipment and piping systems contaminated with TEAL/TEB per written procedures with approved solvents prior to performing any maintenance or repair activities.
   8. Move heavy TEAL/TEB storage cylinders using hand carts.
   9. Utilize PPE as follows:
      a) PPE for quantities less than 5 gallons:
         1) Full body protection - SSC Cryogenic Coveralls (Brownies) purchased to the standard SSC Specification for Flame Retardant Cryogenic Handling Coveralls, consisting of an outer shell of 40% PBI/60% Kevlar Aramid, inner barrier of Goretex PTE, and an inner liner of either 20%PBI/80% Durvil or 100% Nomex trilaminate.
         2) Hand protection - Heavy-duty fire fighters gloves, specifically “Shelby Firewall” made with cow leather.
         3) Head/face protection - PBI “Lifesaver” pullover protective hood (long model). Hardhat with full-face shield attached.
         4) Eye protection - Safety glasses with side shields and a full face shield. Keep the face shield lowered when transferring or otherwise handling TEAL/TEB containers.
         5) Foot protection - Heavy leather boots with high shafts.
         6) Clothing - The coveralls shall be closed, with sleeves extending over the gloves and securely fastened. The coveralls shall extend over the boots without cuffs

that could trap spilled material. The PBI pullover hood should be tucked under the neck opening of the coveralls and the opening closed via the suits fasteners.

b) PPE for quantities greater than 5 gallons:

The NASA SMA office can be contacted to help provide specific guidance in the choice of the following PPE.

1) Full body protection - Complete aluminized protective suit, cape, and leggings.
2) Hand protection - Heavy-duty fire fighter gloves with aluminized outer layer.
3) Head/face protection - Aluminized hood with a full-face shield built integrally to the hood.
4) Eye protection - Safety glasses with side shields. The face shield shall be kept lowered whenever actual transfer operations occur or TEAL containers are handled.
5) Foot protection - Heavy leather boots with an outer covering of neoprene or PVC.
6) Clothing - The coveralls shall be closed, with sleeves extending over the gloves and securely fastened. The coveralls shall extend over the boots without cuffs that could trap spilled material. The PBI pullover hood should be tucked under the neck opening of the coveralls and the opening closed via the suits fasteners.
7) PPE for Sampling Operations/Laboratory Work - Currently no foreseeable requirement exists for TEAL/TEB to be handled within SSC laboratories or for samples to be taken from TEAL/TEB systems. PPE requirements for these two activities will be delayed until such time as they are needed. Personnel, offices, or projects considering these activities should contact the NASA SMA office for guidance in choosing PPE for these operations.

b. Training and Safety Data Sheets - Personnel shall be trained in this procedure and familiar with the SDS for TEAL and TEAL/TEB before handling TEAL or operating a TEAL system.
c. Transportation Safety - TEAL (Organometallic Hypergolic Igniter Compounds) will not be delivered to the warehouse area. The material will be directed to the approved storage site per instructions of the person or office that ordered the material.
d. Procurement/Requisition - According to SSC SPR 8500.2, John C. Stennis Space Center Environmental Operations and Implementation Program Procedural Requirements, a Hazardous Material (HZM) Requisition Form will be completed and the most recent SDS attached to the form. This package will accompany the traditional Material Request (MR) form and be forwarded to the NASA Environmental Officer for approval.
e. Storage Requirements:
   1. TEAL (Organometallic Hypergolic Igniter Compounds) will not be stored in existing flammable/chemical storage facilities at SSC.
   2. Storage will be minimized to the amount needed to support safe and efficient operations and will require justification to the NASA Safety Office prior to use/storage at SSC. All storage sites must be approved by the NASA Safety and NASA Environmental offices

f. Shipping Requirements:
   1. TEAL will be shipped only in special DOT approved containers designed specifically for the material and in compliance with DOT regulations.
   2. Procurement packages for TEAL will include the requirement that the transporter of the material stop at the entrance to SSC and notify the following prior to entrance of the site and delivery of the material:

| | |
|---|---|
| FOS Contract SMA Department | 228-688-6578 |
| FOS Contract Quality & NDE Services | 228-688-1305 |
| FOS Contract Safety & Industrial Hygiene Services | 228-688-1500 |
| FOS Contract Environmental Services | 228-688-1302 |
| FOS Contract Fire Services | 228-688-3439 |

   3. Procurement packages for TEAL will include the requirement that an up-to-date SDS accompany the material and be provided to the user of the material.
   4. TEAL will not be delivered to the warehouse area. The material will be directed to the approved storage site per instructions of the person or office that ordered the material.

g. Laboratory Safety - Currently no foreseeable requirement exists for TEAL to be handled within SSC laboratories. Because of the detailed and unique challenges of working with TEAL in a laboratory environment, the development of requirements will occur when they are needed. Personnel, offices, or projects considering the use of TEAL should contact the NASA SMA Office prior to planning any laboratory activities to allow for the development of this section of the document.

h. Industrial Hygiene:
   1. Eating, drinking, smoking, and carrying of tobacco products is not allowed in areas where there is a potential for exposure to TEAL.
   2. Wash hands and face before eating, drinking, or smoking.
   3. Although inhalation of TEAL is highly unlikely, the American Conference of Governmental Industrial Hygienists (ACGIH) has recommended a Threshold Limit Value (TLV) of 2 $mg/m^3$ as an eight-hour time weighted average for aluminum alkyls.
   4. Train personnel in this procedure and the MSDS for the material before handling TEAL or operating a TEAL system.

#### 5.4.2 Environmental Requirements

Procurement/Requisition - According to SSC SPR 8500.2, John C. Stennis Space Center Environmental Operations and Implementation Program Procedural Requirements, a Hazardous Material (HZM) Requisition Form will be completed and the most recent MSDS attached to the form. This package will accompany the traditional MR form and be forwarded to the NASA Environmental Officer for approval.

a. Storage Requirements - TEAL will not be stored in existing flammable/chemical storage facilities at SSC. TEAL storage containers must be stored in a cool, dry, well-ventilated area away from flammable materials and sources of heat or flame. Storage containers shall be

stored to prevent mechanical damage (e.g., shelves should have lips to preclude containers from falling off; large cylinders shall be secured to prevent tipping, etc.). Storage will be minimized to the amount needed to support safe and efficient operations and will require justification from the NASA Safety Office prior to use/storage at SSC.

All storage sites must be approved by NASA Safety and NASA Environmental. Storage facilities should conform to the requirements of the NFPA, latest edition. Construct storage facilities with noncombustible materials, preferably open sided, and with concrete floors that slope to the outside of the facility. Capture runoff to preclude saturation of moist soils by constructing a dike.

Explosive pockets of hydrocarbon may result from hydrolysis of the TEAL. Small quantities (five (5) gallons or less) may be stored in facilities without sloped floors or curbs, given that the facility design will preclude the spread of the material to other processes/storage sites.

Buildings used for storage of TEAL shall be properly grounded against static electricity and shall have approved lighting protection. Buildings/storage sites used for storing TEAL will be appropriately marked via the NFPA hazard identification system. Conspicuously post the "no smoking in storage areas" notification.

b. Decontamination/Disposal Requirements:
   1. Decontamination - The certified operator will empty the piping systems of TEAL by using up the material or by transferring fluids through a safely designed system. Then he/she will use a dry inert gas to purge all piping previously containing TEAL. The certified operators will evaluate the exhaust of the purge for placement and risks to the process. Systems undergoing routine equipment cleanup/maintenance will be flushed with a hydrocarbon, such as dry kerosene.
   2. Disposal - The certified operator will collect kerosene with residual amounts of TEAL or aluminum oxides and place the material(s) in a sealed drum to preclude evaporation of the kerosene. This residual will be treated as a hazardous waste and disposed of in accordance with SPR 8500.2, John C. Stennis Space Center Environmental Operations and Implementation Program Procedural Requirements. Label waste containers as such.
   3. Disposal of Shipping Containers: Certified operators shall return shipping containers to the manufacturer in compliance with DOT regulations.

#### 5.4.3 Emergency Procedures

The following emergency procedures will be included in written operational procedures for TEAL and will be posted at storage and use locations. Always review the MSDS for current manufacturer recommended procedures.

a. First Aid - If contact with TEAL occurs, immediately start the appropriate procedure recommended below. Simultaneously contact the SSC Emergency Response by dialing 911 from any SSC extension or by calling 228-688-3636 via cell phone.
   1. Ingestion - If swallowed, immediately drink several glasses of water. Do not induce vomiting. This material is corrosive. If vomiting does occur, keep head below hips to reduce the risk of aspiration. Drink fluids again. Have a physician determine if condition

of patient will permit induction of vomiting or evacuation of stomach. Do not give anything by mouth to an unconscious or convulsing person.

2. Skin Contact - Immediately remove all contaminated clothing and shoes. Stand under a safety shower and flush all affected areas thoroughly with large amounts of running water for at least fifteen (15) minutes. Do not attempt to neutralize with chemical agents. Get medical attention immediately. Discard contaminated clothing.
3. Eye Contact - Immediately flush the eyes with large quantities of running water for at least 15 minutes. Hold the eyelids apart during the flushing to ensure rinsing of the entire surface of the eye and lids with water. Do not attempt to neutralize with chemical agents. Obtain medical attention as soon as possible. Do not use oils or ointments at this time. Continue flushing for an additional fifteen (15) minutes if a physician is not readily available.
4. Inhalation - Exposure to combustion products may cause respiratory symptoms. If inhaled, remove the victim to fresh air. If not breathing, clear the victim's airway and start mouth-to-mouth artificial respiration. Keep the person warm and at rest. Get medical attention immediately.

   **NOTE:** Supplemental information for Emergency Response Personnel - Artificial respiration may be supplemented by the use of a bag mask respirator or a manually triggered oxygen supply capable of delivering one liter per second or more. If the victim is breathing, supplemental oxygen may be given from a demand-type or continuous-flow inhaler, preferably with a physician's advice.

b. Fire Fighting - Personnel handling TEAL will not attempt to fight a fire involving the TEAL or other materials in close proximity to a TEAL system or TEAL storage. Operating personnel may attempt to safe a system given that personnel are not exposed to risk of fire or explosion. *Emergency Response Personnel are the only personnel authorized to fight a fire involving TEAL*. The following guidance is provided to minimize the risks to the SSC Fire Department, but ultimately the Commanding Officer in charge of the Fire Department at the time of an incident and holds the ultimate responsibility for deciding the appropriate measures in combating a fire involving TEAL.
   1. Fires that cannot be safely controlled with extinguishing agents should be left to burn until consumed, and adjacent property should be protected with personnel positioned a safe distance from the TEAL fire.
   2. Contact with air due to spillage, ruptures, or leaks will result in spontaneous fires resistant to extinguishment by the more common firefighting agents and methods. The most effective fire extinguishing agent is dry chemical powder pressurized with nitrogen. Vermiculite or dry sand may also be used.

      **CAUTION:** Re-ignition may occur.

      **DANGER: Because water reacts violently with aluminum alkyls, the use of water, water sprays, and chemical and mechanical foams should be avoided.**

3. With large fires, water may be considered for the protection of adjacent structures and equipment, but the practicability of such use can be confirmed only through large-scale tests.

   **DANGER: Do not use Carbon Tetrachloride or Chloro-Bromomethane extinguishing agents because both products react violently or liberate toxic fumes and vapors on contact with aluminum alkyls.**

4. A standard aluminized fire-fighting suit is recommended for fighting aluminum alkyl fires. A NIOSH-approved positive pressure demand type, air supplied, full face piece respirator should be used.

c. Spill Handling - Regardless of the location (transportation, storage, or use) of a spill, the pyrophoric nature of the material presents little options in terms of controlling the material but the following guidelines should help minimize the damage to the site and property. Immediately evacuate all personnel from the scene of any motor vehicle accident involving the transport of TEAL or the accidental release within a storage area or from a TEAL system. The SSC Fire Department should be immediately notified by calling 911 from any SSC extension or by calling 228-688-3636 from a cell phone. If systems can be safely secured, all sources of the spill should be blocked off. After a fire has occurred and been extinguished or burned out, large amounts of water can be used to wash the affected area.

   CAUTION: Water may cause re-ignition to occur. Water should be collected by diking appropriate drainage sites. This water should be disposed of properly and not allowed to enter into waterways.

## 5.5 Safety Requirements for Gaseous and Liquid Hydrogen

This procedure outlines the hazards involved and identifies the applicable codes and procedures to provide a practical set of requirements and guidelines for the safe storage, handling, and use of gaseous, liquid, or slush hydrogen. This safety procedure is applicable to all personnel engaged in the design, construction, and operation of hydrogen storage, transfer, conversion, and pressurization facilities. NASA/SSC and its contractors shall abide by ANSI/AIAA G-095-2004, Guide to Safety of Hydrogen and Hydrogen Systems, for all safety issues regarding liquid and gaseous hydrogen systems. NASA/SSC and its contractors engaged in the design, construction, and operation of hydrogen storage, transfer, conversion, and pressurization facilities shall develop and abide by procedures respective to their operations. Procedures shall provide a practical set of requirements and guidelines for the safe storage, handling, and use of gaseous, liquid, or slush hydrogen.

### 5.5.1 Responsibilities

a. Managers/Supervisors:
   1. Managers and supervisors of all contractor, agency, and NASA organizations are responsible for compliance to and implementation of the requirements of this safety procedure.

2. Managers and supervisors of organizations engaged in hydrogen operations are responsible for developing and maintaining detailed operating, maintenance, and emergency procedures. Procedures shall include safety requirements, required safety equipment, and safety warnings and cautions necessary to carry out the operations.
3. Communications (radio, headset, intercom, or similar equipment) shall be maintained during liquid and gaseous hydrogen operations. Communications equipment used with the operations will be intrinsically safe.

b. Cognizant Safety Organizations:
1. Safety offices shall provide qualified Safety representatives for monitoring hydrogen operations to ensure compliance with the provisions of this safety procedure.
2. Contractor and agency safety organizations shall develop safety procedures/standards specific to the type of hydrogen operations in which they are engaged, if applicable.
3. Safety organizations shall review all design drawings and operational procedures for inclusion of appropriate safety provisions. Designate all procedures involving liquid hydrogen as Safety Critical.
4. An Operational Readiness Inspection (ORI) or Safety Review Team (SRT) as deemed appropriate by the NASA/SSC SMA Office shall verify the safe design and use of newly installed or heavily modified hydrogen systems prior to first use. The ORI/SRT shall ensure that the safety of personnel at or near the facility has not been compromised and that the facility has been designed and built to meet accepted standards and guidelines and complies with established regulatory codes.

### 5.5.2 General Requirements

a. Inerting the System - No welding, grinding, or cutting is permitted on any liquid or gaseous hydrogen systems without first inerting the system. (**Exception:** Removal of paint from the outer surface of storage vessels (paint visually removed via grinding) and buffing of welds or surface anomalies for the purposes of visual inspection and non-destructive testing for pressure vessel and pressure systems inspections under the NASA/SSC Pressure Vessel and Systems Recertification Plan.) The system will be checked to ensure that hydrogen has been successfully removed during the inerting operation prior to initiation of work.
b. Loading and Unloading - When loading or unloading liquid or gaseous hydrogen transporters, shut off engines and make sure the transporter tank is grounded prior to the hookup, and keep it grounded until transfer lines/hoses have been disconnect from tank.
c. Electrical Storms - If an electrical storm approaches within five (5) miles of the working area, stop hydrogen transfer and/or venting operations, secure the system(s), and clear personnel from the working area.
d. Storage Vessel Inspection - Periodically inspect liquid hydrogen ($LH_2$) storage vessels for pressure build-ups while in transit and vent as necessary.

### 5.5.3 Environmental Requirements

No specific environmental constraints exist with respect to using or accidental spillage of hydrogen (gaseous or liquid). Treat any accidental spillage of a quantity (levels to be determined

for each program/process) of liquid hydrogen as an emergency release of flammable liquid and take emergency precautions to protect life and property.

## 5.6 Safety Requirements for Liquid/Gaseous Oxygen Systems

a. NASA/SSC and its contractors shall abide by Oxygen Standard (ASTM Manual 36, Manual for Safe Use of Oxygen and Oxygen Systems: Guidelines for Oxygen System Design, Materials Selection, Operation, Storage and Transportation) for all safety issues regarding liquid and gaseous oxygen systems.
b. Requirements shall be included in all SSC and contractor written procedures.

## 5.7 Cryogenics Safety

This procedure provides requirements for the safe handling of cryogenics and the safe operation of cryogenic systems at SSC. NASA/SSC and its contractors whose personnel are involved in the handling of cryogenics shall develop and adhere to procedures respective to their operations. Procedures shall provide requirements for the safe handling of cryogenics and the safe operation of cryogenic systems at SSC. The procedures include top-level requirements for cryogenic safety, including Liquid Hydrogen ($LH_2$), liquid oxygen (LOX), liquid nitrogen ($LN_2$), and liquid helium (LHe), as well as emergency procedures and environmental concerns.

More detailed specific requirements for hydrogen and oxygen are provided in other subparagraphs.

### 5.7.1 Management/Supervision Responsibilities

Only personnel properly trained and certified for managing cryogenics by the cognizant, management authority shall engage in operations involving cryogenics. Such personnel shall be familiar with the hazards associated with the particular cryogen and the appropriate safety precautions to be observed.

### 5.7.2 Requirements

a. General:
    1. Drawings shall reflect all cryogenic system modifications immediately following completion of work.
    2. Store cryogenic liquid containers in well-ventilated areas. They must be handled carefully and not dropped, rolled, or tipped on their sides. They shall be secured against overturning, including during transport. Use storage precautions appropriate to these materials in gaseous form when storing them in cryogenic liquid form.
    3. When cryogenic liquids are being used to cool an object, the object shall be inserted into the liquid slowly to minimize boiling and splashing. Use tongs to insert the object or to withdraw it after cooling. Never use cryogenic liquids to cool ordinary compressed gas cylinders made of carbon steel, which lose impact resistance at cryogenic temperatures.
b. Systems:
    1. If ice plugs form, remove the container to a remote location and notify the cognizant, Safety representative for safety instructions.

2. Leak test all cryogenic equipment/systems at the normal operating pressure to verify system integrity.

c. Leak and Fire Detection Systems - Ventilate all working areas where cryogenic liquids are used and install monitoring/alarm systems to detect and alert personnel to hazardous concentrations of vapors and/or lack of oxygen.

d. Personal Protective Equipment:
   1. PPE shall always be worn when engaged in cryogenic operations.
      a) Eye protection shall provide top, side, and front protection; goggles and face shields are most effective.
      b) Gloves shall be leather or insulated and have a relatively loose fit; if they accidentally contact cryogenic liquid, loose gloves can be removed easily before they become frozen to the hand.
      c) Wear a long-sleeved lab coat, smock, coveralls, or other protection as required; avoid having open pockets, trouser cuffs, or other catch points where a spill could accumulate. Do not wear watches, rings, or jewelry because they can become frozen to exposed skin.
   2. The following PPE are required for each specific cryogen, as a minimum when performing liquid nitrogen operations: coveralls or smock, face shield (with hardhat if required by the face shield) and chemical splash goggles, and cryogenic handler gloves.
   3. Where a significant splash hazard exists, wear safety shoes with soles and heels of semi-conductive rubber.

e. Liquid Nitrogen Equipment and Materials:
   1. Nonmetal materials shall be selected to withstand the low temperatures associated with liquid nitrogen service.
   2. Use only approved materials for pipes, fittings, and hydrostatically tests construction at specified pressures. Whenever possible, use welded and flanged connections.
   3. Use only hoses that are of engineering design specifically for cryogenic service.
   4. Monitor liquid nitrogen equipment with pressure gauges. To minimize operator-reading errors, all pressure gauges used for a common purpose should have identical scales.
   5. Large storage containers shall be vacuum-insulated tanks. Equip the insulated area between the inner and outer shells with either a rupture disc or a pressure-relief device. The storage container itself shall be of welded construction and shall be equipped with an adequate vent line and pressure-relief devices. These vents shall discharge to the outdoor atmosphere. All lines and vessels in which liquid nitrogen may be trapped between closed valves will be equipped with relief valves. If there is any likelihood that the relief valve may freeze, associated vessels and lines shall also be equipped with rupture discs.
   6. Liquid nitrogen may be stored and shipped in small cylinders or containers specifically designed to hold low-temperature, liquefied gases. Containers designed for low-temperature liquids should be either open or protected by a vent or other pressure-device that permits vapors to escape. When a special vented stopper or venting tube is used, check the vent at regular intervals to ensure it is not plugged with ice. Use only the stopper supplied with the container.

## 5.8 Safety Requirements Pressure Systems

This procedure outlines the responsibilities and requirements for the safe operation, and maintenance of pressure vessels and systems (PVS). The requirements for the design, fabrication and installation of PVS are referenced in NASA STD-8719.17, NASA Requirements for Ground-Based Pressure Vessels and Pressurized Systems (PV/S). The requirements for the repair and alteration of PVS are referenced in SPR 1740.1, Pressure Vessel and Pressurized System Procedural Requirements. Other PVS related requirements can be found in SCWI-8838-002, Hot Work Permit Program Procedure; SCWI-8715-0013, Control of Hazardous Energy Lockout/Tagout; and SCWI-8715-0004, Confined Space Procedures; SSTD-8070-0095-PRESSUR, Pressurization Standard in Support of the Recertification of Pressure Vessels and Pressure Systems; SSTD-8070-0097-TEST, Relief Devices – Inspection and Recertification;. NASA/SSC and its contractors shall develop and comply with procedures respective to their operations

The following responsibilities and requirements apply:

a. General Requirements:
   1. Hand-operated valves should be installed around pressure-reducing valves only if the downstream system is designed for the maximum source pressure or it is protected from overpressure by relief devices.
   2. Isolation valves should not be installed between positive displacement compressors and their receivers unless a pressure relief device is installed between the isolation valve and the compressor.
   3. Bulk storage flammable/combustible liquid pressure systems will be equipped with water deluge systems for fire protection.
   4. Personnel shall be trained and certified in accordance with SCWI-3410-0003 prior to operating a pressurized system.
   5. Operations involving high-pressure systems shall be classified as Safety Critical.
   6. The Buddy System shall be used during all pressure system operations.
   7. During pressure testing activities, when the maximum allowable working pressure (MAWP) or the design pressure of the pressure vessel or system is exceeded, access shall be limited to essential personnel only.
   8. When any part of a pressure system is an integral part of a vacuum system and the safety requirements of the two systems are conflicting, the stricter requirements shall take precedence.
   9. Hazardous fluids will not be used as test media during pressure tests.

b. Components Requirements:
   1. Pressure Relief Devices:
      a) Pressure systems shall be protected by pressure relief devices (PRD) when the source pressure can exceed the design pressure of the system, the malfunction/failure of any component can result in system pressure exceeding design pressure, or when process fluid pressure build-up can be expected.

b) Pressure relief devices shall be installed downstream of pressure regulating devices and orifices unless the downstream portion of the system is capable of accepting the maximum source pressure.

c) Overpressure protection for Pressure Vessels and systems shall be in accordance with the applicable National Consensus codes and Standards

d) Exhausts from relief valves and rupture/burst discs shall be installed such that personnel injury or equipment damage in the event of actuation.

CAUTION: In the event where work is performed in the vicinity of the PRD, a worksite analysis shall be performed, such as a Safe Plan of Action (SPA), and proper precautions shall be taken.

e) Where relief extensions are used, they shall be adequately secured to restrain the thrust developed in the event of a release.

2. Pressure Indicating Devices (Pressure gauges and transducers):
   a) Pressure indicating devices (PID) shall meet the requirement of NASA-STD 8719.17.
   b) Pressure indicating devices (PID) shall be used on main pressure systems or portions of systems that can be isolated from the main system. When the PID is the sole pressure-indicating instrument or has the potential to become the sole-pressure indicating instrument in the isolated system, the PID shall be classified as a primary gauge. This does not apply to pressure vessels or systems that have been down-moded.
   c) Primary gauges are considered safety- related devices and shall meet the requirements of NASA-STD 8719.17.
   d) Gauges that are not safety-related devices should be labeled "No Calibration Required" to the extent possible.
   e) Operating pressure
      1) Pressure gauges should have full-scale pressure such that the operating pressure occurs in the middle half (25% to 75%) of the scale.
      2) The full-scale pressure should be approximately 2 times the intended operating pressure.
      3) Should it be necessary for the operating pressure to exceed 75% of full scale, a competent engineer shall be consulted.
   f) Near zero pressure
      1) Use of pressure gauges near zero pressure is not recommended because the accuracy tolerance may be a large a percentage of the applied pressure.
      2) A venting device shall be used to completely reduce the system pressure to zero.
   g) Pressure gauges shall have shatter-proof fronts and blow-out back panels.
   h) When practicable, pulsating dampeners, orifice plates, or similar devices should be installed at each gauge location if the gauge:
      1) Undergoes frequent surge pressure.
      2) Is installed in an inert-gas system in a closed area with inadequate ventilation.

3) Is used in a system with toxic, corrosive, or flammable fluids.
4) Pressure gauges with a case that can be pressurized (i.e., Wallace & Tiernan) during operation are to be provided with a relief valve sized to ensure the maximum case pressure is not exceeded.

3. Flexible Hoses:
   a) Flexible hoses shall meet the requirements of NASA-STD 8719.17.
   b) Flexible hoses shall be certified for use with tag(s) identifying serial number and information stating: Maximum Allowable Working Pressure (MAWP), test pressure, date of original pressure test or retest, Quality Control (QC) mark or stamp, and Stennis Work Request (SWR) or other work document number for traceability.
   c) Flexible metal hoses shall have end restraints and be placed at intervals not to exceed 6 ft. in gas systems with pressures of 150 psig or greater to secure against whipping in the event of failure. Where practicable, this should also be done for systems operating at less than 150 psig
   d) Flexible hoses not permanently installed and not considered a permanent part of a system and subject to periodic removal, storage, and/or reinstallation require initial pressure testing, visual inspection prior to use, and retested at the flexible element Maximum Allowable Working Pressure (MAWP) at least every five (5) years.
   e) Flexible hoses that are permanently installed by welding or brazing shall be included as part of the PV/S inspection and testing requirements, and the retest requirement of paragraph"5.8.b.3.c" does not apply.
   f) Rubber or other similar flex hoses used for shop air, air driven tools, low pressure breathing air, etc. do not require pressure testing, but shall be removed from service when there is evidence of wear, damage, cracks, abuse, or other indications of potential failure.
   g) Flexible hoses shall be visually inspected prior to each use and removed from service if any of the following conditions exist:
      1) No certification tags attached to the flexible hose.
      2) Deformations such as kinks or flattened spots
      3) Broken wire such that more than one-half of the individual elements (strands) in any one braid (plait) of the outer reinforcing jacket are broken.
      4) Heat damage evident by a yellow or light brown discoloration.
      5) Damaged end connections
      6) Leakage
      7) Splitting or Cracking

## 5.9 Explosive Safety

This procedure provides assigned personnel and customers of SSC the safety requirements in addition to existing regulations regarding shipping, handling, using, and storing explosives within the confines of SSC. NASA/SSC and its contractors involved in the shipping, handling, use, and storage of explosives within the confines of SSC shall develop and follow explosives

safety procedures. Stennis Procedural Requirements (SPR) 6330.1 shall outline the responsibilities and requirements for shipping, handling, use, and storing of explosives.

## 5.10 Process Safety Management

Process Safety Management (PSM) requirements are contained in SCWI-8715-0010, John C. Stennis Space Center Process Safety Management (PSM) program.

## 5.11 Safe Handling of Hydrocarbon Based Propellants

This procedure outlines the associated hazards, necessary safety precautions, and requirements to be observed when working with RP-1 or any Hydrocarbon Fuels.

### 5.11.1 General Safety Requirements

a. Written Procedures - A written operating procedure shall be used for all operations involving RP-1 and all Hydrocarbon Fuels.
b. Safety Radius - All sources of ignition shall be prohibited within a fifty (50) feet radius of areas where rocket propellant (RP-1) or any Hydrocarbon Fuel is handled, stored, and used. Any work activity performed within the radius shall be accompanied by a flame permit from the SSC Fire Department and approval from the cognizant, safety representative.
c. Venting - Vapors should be vented or flared at remote locations.
d. Safety Critical Classification - All areas of operation where RP-1 or any Hydrocarbon Fuel is used, handled, transferred, or stored are considered hazardous and will be classified as Safety Critical.
e. Buddy System - The "Buddy System" philosophy shall be enforced when performing any RP-1 or Hydrocarbon Fuel operations.

### 5.11.2 Emergency Procedure

In the event of an RP-1 or Hydrocarbon Fuel spill that extends beyond the means of retention, personnel must call 911 from an SSC phone extension or via cell phone by dialing 228-688-3636 and give the location and a brief description of the incident. In case of a fire, the nearest fire alarm shall be activated.

### 5.11.3 Environmental Requirements

For environmental requirements, refer to SPR 8500.2, John C. Stennis Space Center Environmental Operation and Implementation Program Procedural Requirements.

### 5.11.4 Materials and Equipment Compatibility

a. Liquid Reservoir - Permanently installed pumps in main storage systems may also be equipped with a liquid reservoir to serve as a primer for the pump used to empty vessels not equipped with bottom outlets.
b. Gages - Gages for RP-1 or Hydrocarbon Fuel service shall be selected in accordance with SSC-66-200, Bourdon Tube Pressure & Vacuum Gauges for Use in Facility Piping or Tubing Systems. To minimize operator errors, all pressure gages used for a common purpose should have identical scales.

#### 5.11.5 Transportation

For specific transportation requirements, refer to the applicable section(s) of the DOT Code of Federal Regulations, Title 49.

### 5.12 Critical Lifting Operations

Critical Lifting procedures can be found in, SWI-8834-0001 John C. Stennis Space Center Lifting Devices and Equipment Management Instructions.

### 5.13 Emergency Fire Evacuation Drills

Fire Drills - As a minimum, a yearly fire drill shall be conducted of all work areas/buildings at SSC. The fire drill shall be conducted by the SSC Fire Department, with fire department personnel stationed throughout the building/facility to time and observe the evacuation. Building custodians/supervisors of work areas are responsible for providing assistance to the fire department during the fire drill. A written report of the activity including deficiencies (if any) shall be prepared by the Fire Department and forwarded to NASA Safety. NASA Safety shall be responsible for ensuring the appropriate facility manager/supervisor is made aware of any problem areas and has these corrected by the responsible party in a timely manner. False alarms shall not be recognized as a Fire Drill.

### 5.14 Fire Symbols

#### 5.14.1 Fire Symbols

This procedure outlines the general requirements for the use, selection, and posting of fire symbols at SSC. It is not the intent of this instruction to address every labeling requirement for areas in which large storage vessels of flammable/combustible liquids, hazardous materials, or any quantity of ammunition or explosives are stored/handled, but rather to focus on the more common requirements at SSC and provide the “Basic Authority Documents” that will provide a broader range of guidance/requirements for labeling such areas.

#### 5.14.2 Responsibilities

It is the responsibility of facility managers or operational leads to ensure the proper fire symbols/warning signs are provided and installed.

#### 5.14.3 Requirements

a. Conformance to Regulations and Standards - Danger signs and labeling used shall conform to requirements specified by 29 CFR 1910.145.
b. Display of Explosive Fire Symbols for Transportation - Fire symbols/DOT placards shall be placed on all transport vehicles immediately prior to loading and shall be removed from the vehicles immediately upon completion of unloading.

### 5.15 Safety Requirements for Using/Storing/Dispensing Gasoline

This procedure outlines the basic safety requirements to be observed when working around gasoline.

#### 5.15.1 Specific References

NASA-Std 8719.11 Safety Standard for Fire Protection
29 CFR 1910.145, Specifications for Accident Prevention Signs and Tags

#### 5.15.2 General Requirements

a. Spill Handling and Reporting - In the event a small spill occurs, the gasoline will be flushed with water. Large spills (greater than five (5) gallons) will be reported to the Spill Response Team and the cognizant, safety officer by calling ext. 911 from an SSC phone extension or via cell phone by dialing 228-688-3636.
b. Maintenance and Inspection of Storage Containers - Perform periodic maintenance and inspections of gasoline storage containers to identify external damage or deformation, corrosion, need for lubrication, cleanliness and adequate general housekeeping, and proper pressure relief mechanisms. NASA-STD 8719.11 c.
c. Safety Critical Classification - Classify configuration changes to gasoline storage containers and related systems as Safety Critical.
d. Use of Gasoline for Cleaning - Do not use gasoline as cleaning solvent.
e. Portable Heating - Do not use portable gasoline stoves for heating purposes, unless specifically approved by the NASA/SSC SMA Directorate.

### 5.16 Natural Gas Systems

This outlines the basic safety requirements to be observed when working around natural gas systems.

#### 5.16.1 General Requirements

a. Safe Distance - Do not smoke or allow other possible ignition sources within fifty (50) feet of gas piping, gas utilization equipment, or accessories.
b. Static Grounding - Statically ground all natural gas lines and related components.
c. Relief Valves - Relief valves, which are inspected, tested, and reset annually, are included in natural gas systems.

#### 5.16.2 Operational Requirements

Installation and replacement of gas piping, gas utilization equipment, or accessories, and repair and servicing of equipment is Safety Critical and shall be performed only by qualified personnel. The term "qualified personnel" means trained and competent in the safe and proper operations, maintenance, and repair of natural gas systems, to include installation or replacement of piping or the connection, installation, repair, or servicing of natural gas equipment. The aforementioned work requirements shall be accomplished in accordance with an approved operating procedure or process plan.

### 5.17 Specific Records and Forms

All records and forms are assumed to be the latest version unless otherwise indicated. Quality Records are identified in the SSC Master Records Index.

a. Hazardous Material (HZM) Requisition Form
b. Material Request
c. TEAL MSDS
d. SSC Form 720, Explosive License
e. SSC Form 68, Hot Work Permit
f. SSC Form 559, Report of Industrial Injury or Illness

## 6.0 CONSTRUCTION SAFETY AND HEALTH OPERATING PROCEDURES

The Construction Safety and Health program requirements are contained in SCWI-8715-0008, John C. Stennis Space Center Construction Safety and Health Program.

## 7.0 ACRONYMS, ABBREVIATIONS, AND DEFINITIONS

### 7.1 Acronyms

| | |
|---|---|
| ACGIH | American Conference of Governmental Industrial Hygienists |
| ACM | Asbestos-Containing Materials |
| AED | Automated External Defibrillator |
| AHJ | Authority Having Jurisdiction |
| AMO | Aircraft Management Office |
| ANSI | American National Standards Institute |
| ASO | Aviation Safety Officer |
| ASTM | American Society for Testing and Materials |
| ATC | Air Traffic Controller |
| ATP | Airline Transport Pilot |
| ATV | All-Terrain Vehicle |
| CAR | Corrective Action Report |
| CEF | Central Engineering Files |
| CFR | Code of Federal Regulations |
| CHO | Chemical Hygiene Officer |
| CM | Configuration Management |
| dBA | decibel level measured on the “A” scale |
| D&CR | Discrepancy Report used by FOSC |
| DoD | Department of Defense |
| DOP | Detailed Operating Procedure |
| DOT | Department of Transportation |
| EH | Environmental Health |
| EMS | Emergency Medical Services |
| EMT | Emergency Medical Technicians |

| | |
|---|---|
| EWR | Engineering Work Requests |
| FAA | Federal Aviation Administration |
| FARs | Federal Aviation Regulations |
| FCPF | Fluid Component Processing Facility |
| FOS | Facility Operating Services |
| FOSC | Facility Operating Services Contractor |
| FRB | Facilities Review Board |
| FRI | Facility Risk Indicators |
| FRR | Flight Readiness Review |
| $GH_2$ | Gaseous Hydrogen |
| GMAL | Gas Material Analysis Lab |
| $GN_2$ | Gaseous Nitrogen |
| $H_2$ | Hydrogen |
| $H_2O_2$ | hydrogen peroxide |
| HAZMAT | Hazardous Materials |
| HAZWOPER | Hazardous Waste Operations and Emergency Response |
| He | helium |
| HRI | Hazard Risk Index |
| HRPS | Hazard Reduction Precedence Sequence |
| HZM | Hazardous Material |
| IRIS | Incident Reporting Information System |
| LDE | Lifting Devices and Equipment |
| LDEM | LDE Manager |
| LEL | Lower Explosive Limit |
| LH2 | liquid hydrogen |
| LHe | liquid helium |
| LN2 | liquid nitrogen |
| LO | lockout |
| LOTO | lockout/tagout |
| LOX | liquid oxygen |
| LP | liquid propane |
| MAWP | Maximum Allowable Working Pressure |
| mph | miles per hour |
| MR | Material Request |
| MS&CL | Measurements, Standards and Calibration Lab |
| MSDs | Musculoskeletal Disorder |
| NASA | National Aeronautics and Space Administration |
| NDE | Non-Destructive Examination |
| NEW | Net Explosive Weight |
| NFPA | National Fire Protection Association |
| NIOSH | The National Institute for Occupational Safety and Health |
| NPR | NASA Procedural Requirement |

| | |
|---|---|
| NSTC | NASA Safety Training Center |
| O2 | oxygen |
| OEM | Original Equipment Manufacturer |
| OHS | Occupational Health Services |
| OI | Operating Instruction |
| ORA | Operational Readiness Assessment |
| ORI | Operational Readiness Inspection |
| OSHA | Occupational Safety and Health Administration |
| PEL | Permissible Exposure Limit |
| PPE | Personnel Protective Equipment |
| PR | Problem Report |
| psia | pounds per square inch absolute |
| psig | pounds per square inch gauge |
| PSM | Process Safety Management |
| QC | Quality Control |
| QD | Quality Distance |
| ROPS | Rollover Protective Structures |
| RPV | Remotely Piloted Vehicles |
| RSC | Radiation Safety Coordinator |
| RSO | Radiation Safety Officer |
| SDS | Safety Data Sheet |
| SMA | Safety and Mission Assurance |
| SATERN | System for Administration, Training, and Educational Resources |
| SCBA | Self Contained Breathing Apparatus |
| SCWI | Stennis Common Work Instruction |
| SPR | Stennis Procedural Requirements |
| SRT | Safety Review Team |
| SSC | John C. Stennis Space Center |
| SSCRA | Stennis Space Center Recreation Association |
| SSCRC | Stennis Space Center Recreation Center |
| SSTD | Stennis Space Center Standard |
| STD | Standard |
| SWR | Stennis Work Request |
| TEAL | Triethylaluminum |
| TEB | Triethylborane |
| TLV | Threshold Limit Valve |
| TO | tagout |
| TOC | Test Operations Contractor |
| TPS | Test Preparation Sheet |
| TWA | Time Weighted Average |
| UAS | Unmanned Aerial Systems |
| UAV | Unmanned Aerial Vehicles |

| | |
|---|---|
| UV | Ultraviolet |
| VFR | Visual Flight Rules |

### 7.2 Definitions

**Critical Person** – Any person who makes real-time decisions or performs real-time actions that could directly affect personnel safety and/or operational mission accomplishment.

**DANGER Tag** – A tag used to provide an immediate alert of a hazardous or unsafe condition or process that might result in personnel injury or property damage in the event a component, system, or process is activated or utilized prior to corrective action being accomplished.

**Detailed Operating Procedure (DOP)** – The step-by-step procedure for performing tasks associated with research and development activities/experiments or propulsion test activities.

**Hazardous Operations** – Operations involving materials or equipment that have a high potential to result in loss of life, serious injury to personnel, or damage to systems, equipment, or facilities (e.g., laboratory operations, high-pressure gas operations in excess of 150 psig, low-pressure high volume gas operations, voltages above six hundred (600) volts, storage and handling of liquid or solid propellants, storage and handling of explosives, use of "heavy lift" material handling equipment associated with critical lifts, extreme temperature environments, environments with less than 19.5% or more than twenty-five percent (25%) oxygen by volume at normal atmospheric temperature and pressure, confined space entries, lockout/tagout operations associated with pressure systems, electrical systems, or mechanical systems). A potentially dangerous process or series of acts involving hazardous materials or chemicals, technology, or systems with potential hazards to life, the environment or property.

**Hazardous Operational Certification** – A process that both documents and demonstrates the employee's capability to safely perform unique skills and/or specialized work associated with hazardous operations.

**Hot Work Permit** – NASA/SSC written authorization (Hot Work Permit, SSC Form 68), to perform operations that requires flame producing equipment. This form is issued only by the SSC Fire Department.

**Laboratory** – A laboratory is a facility where the "laboratory" use of hazardous chemicals occurs.

**Lightning Protection System** – A complete system of air terminals, conductors, ground terminals, interconnecting conductors, arresters, and other connectors or fittings required to complete the system.

**Lockout/Tagout** – The placement of a LO device on an energy isolating device, in accordance with an established procedure, ensuring that the energy isolating device and the equipment being controlled cannot be operated until the LO device is removed.

**Off-site Contractor** – A contractor hired to perform temporary work at SSC (e.g., a construction contractor, a field radiography service, etc.).

**Operating Procedure** – A detailed step-by-step procedure listing the functions, work tasks, safety precautions, tools, and materials by which a person or team will perform a work or test activity. A good procedure ensures that work is accomplished in a safe and efficient manner.

**PBI and PTE** – Flame retardant fabric used in PPE.

**Personal Protective Equipment** – "Equipment designed to protect employees from serious workplace injuries or illnesses resulting from contact with chemical, radiological, physical, electrical, mechanical, or other workplace hazards. Besides face shields, safety glasses, hard hats, and safety shoes, PPE includes a variety of devices and garments such as goggles, coveralls, gloves, vests, earplugs, and respirators."

**Process Skill Certification** – A process that both documents and demonstrates the specific training required to demonstrate proficiency in a skill associated with the quality of an end product or task.

**Pyrophoric** – The action of spontaneously igniting in air.

**Radiation Safety Coordinator** (RSC) – The NASA manager of the radiation safety program for Stennis Space Center.

**Radiation Safety Officer** (RSO) – One who has the knowledge and responsibility to apply appropriate radiation protection regulations. Contractors and tenant agencies are required to have an RSO if they have licensable radiation sources or use licensable sources at their facilities or in their operations/activities located within the confines of SSC.

**Responsible Organization** – Those accountable for the specific duties that are performed to produce a desired result or effect (e.g., NASA Directorates, Prime contractors).

**Safety Critical** – Safety Critical includes any operation, process, or procedure involving materials, equipment, or tasks that have a high potential to result in loss of life, serious injury to personnel, and/or damage to systems, equipment, or facilities. These include but are not limited to laboratory operations; high-pressure gas operations in excess of 150 psig; low-pressure high volume gas operations; voltages above five hundred and fifty (550) volts; storage and handling of liquid or solid propellants; storage and handling of explosives; use of "heavy lift" material handling equipment; extreme temperature environments; oxygen-deficient or -enriched environments; confined space entries; and lockout/tagout operations associated with pressure systems, electrical systems, or mechanical systems.

**Servicing/maintenance** – Workplace activity such as constructing, installing, setting up, adjusting, inspecting, modifying, and maintaining and/or servicing machines or equipment. These activities include lubrication, cleaning, or fixing jammed machines or equipment, and making adjustments or tool changes, where the employee may be exposed to the unexpected energization or startup of the equipment or release of hazardous energy.

**Test Preparation Sheets (TPS)** – A procedural document used to authorize and describe test activation/operation and associated manufacturing tasks not covered by DOPs. TPSs are

generally used by Test Operations personnel to document daily work activities of personnel associated with test programs.

**Unqualified Persons** – Persons not properly trained in the operations and associated hazards of a process, procedure, or task. This also includes individuals who are not properly trained and certified for specific programs as required by regulatory guidance (i.e., respiratory protection use, confined space entry, asbestos abatement, etc.).

**Voltage (High)** – Over six hundred (600) volts.

**Work Authorizing Document (WAD)** – Approved detailed documentation used to implement processes or operations.

## Appendix A– Recreational Facilities

### RULES/GUIDELINES FOR USING THE

### RECREATIONAL AREAS AT STENNIS SPACE CENTER

### A.1 Recreational Activities

a. Swimming is prohibited in all areas other than the Wellness Center's lap pool.
b. Children are not allowed at river's edge or in the woodlands unless escorted by an adult.

**WARNING: Alligators can be found by the river's edge.**

**DO NOT FEED THE ALLIGATORS. Feeding alligators constitutes harassment of a protected species per Mississippi Code 49-5-101 through 49-5-119. Violators shall be fined $1,000 or be imprisoned for one year or both.**

c. Adults responsible for the care of children are encouraged to supervise their children's activities on the playground equipment at the SSC Child Care Facility.
d. Volleyball is allowed only at the permanent sand volleyball courts located near the intersection of Upper Gainesville Rd. and Lower Gainesville Rd. Volleyball is not allowed at the pavilion area.
e. The game of horseshoes is allowed only at the horseshoe pit areas. The players of the game are responsible for watching for others and assuring their safety prior to throwing the shoes.
f. The game of lawn darts is prohibited at SSC.
g. Fireworks are prohibited.
h. Watch for Snakes: All visitors must recognize that the Cypress House recreational area is a rural site. Visitors should always be cognizant that poisonous snakes may be present. Employees should watch where they step and be especially careful if they are picking up or moving materials.
i. In the event of a severe thunderstorm, persons should seek shelter to avoid related hazards.
j. In the event of severe lightning activity, visitors should seek cover inside the Cypress House, under the metal-covered pavilion, or inside an enclosed vehicle with a metal top and body.

**WARNING: Persons inside a building should avoid open doors and windows. Persons under the pavilion should stay six (6) feet away from the edge of the facility because of the metal structure of the facility. If a person is too close to the metal, he/she runs the risk of being struck by lightning traveling through the metal structure.**

k. In the event of a FIRE or need of Emergency Ambulance Service or security, contact NASA Emergency response at extension 911 or at 228-688-3636 from a cell phone. Provide the Emergency Response Officer information as to location (e.g., Cypress House Recreational Area) and nature of the incident. Do not hang up the phone unless directed to by the Emergency Response Officer.
l. Persons should be cognizant that children are present and be especially careful when backing their automobiles or driving through the recreational area.

## A.2 Picnicking Activities

a. Bonfires/open campfires are not allowed without prior approval of NASA SMA and SSC's Fire Chief.
b. Charcoal fires will be started only with approved charcoal lighter fluid. Gasoline or other flammable liquids shall not be used to start a charcoal fire.
c. No alcoholic beverages shall be brought onto Stennis Space Center from offsite. All alcoholic beverages purchased through the Recreational Association's Cypress House must be consumed on the site. Only wines and beer of ten percent (10%) alcohol (by volume) or less may be consumed on the premises.
d. Persons who exhibit signs of intoxication shall not be allowed to drive off the premises. Do not provoke a resistive intoxicated individual who insists on driving. Please notify SSC Security to handle the situation.
e. Personal/Private Liquid Propane (LP) Gas Cookers and LP Tanks
    1. LP gas bottles shall have a regulator and fuel hose that matches the designed pressure and intended use. The twenty (20) pound LP gas regulator shall control the pressure to less than 1 psig.
    2. LP bottles having both vapor phase and gas phase connections are prohibited.
    3. LP bottles shall have only approved connections and fuel hose.
    4. Cooking containers will be of single wall construction. Lids to containers must be designed so that they cannot be locked in a closed position.
    5. Tanks must have a means of spreading flame or heat over a large area of the cooking vessels.
    6. LP gas tanks shall have valve shields.
    7. LP gas tanks must be in good condition with manufacturer's data tag or Department of Transportation (DOT) data stamped on valve shield and clearly legible.
    8. LP gas bottles shall not be cross-connected to fill a smaller bottle from a larger bottle.

## A.3 Volleyball Courts

Prior to play, inspect the sand courts for glass bottles or cans that could pose a hazard to those playing the game.

## A.4 Softball Fields

a. Prior to play, the fields should be inspected for glass bottles, rocks, or cans that could pose a hazard to those playing the game.
b. Softball is the only form of ball game allowed at the SSC softball fields. (T-ball with a soft-rag ball is an acceptable form of the game for children.)
c. The wearing of steel spikes by players of the game is prohibited.
d. Bases shall be of the type that will move in circular motion within a specified area and shall not present a solid immovable object that will cause injury to the lower extremities when a player slides against it.
e. A general release and hold harmless statement must be signed by participants of softball games sponsored by the SSC Recreation Association.

## Appendix B – Explosive Safety Submission/Site Planning

The following provides guidance for determining when an Explosive Safety Submission/Site Plan is required and generally what is expected in the documentation package.

a. Safety approval of site plans and general construction plans must be obtained from the cognizant safety engineer and NASA/SSC Office of Safety and Mission Assurance for the following types of facilities and operations:
   1. Facilities used for handling, transporting, storing, testing, or maintaining explosives, liquid propellants, solid propellants, pyrotechnics, and ammunition.
   2. Operations that increase exposure of personnel, equipment, or resources to explosives.
   3. Operations that increase the Net Explosive Weight (NEW) of storage or operating location.
   4. Operations that alter an explosive facility major support structures, such as beams or girders.
   5. Operations that cause a reduction in the blast or fragment suppression capability of walls, doors, etc. of an explosives location.
   6. Operations that result in permanent reduction in the effectiveness of explosion protection systems, such as explosion-proof lighting, wiring, or motors, where such protection systems are required.
   7. Operations that remove any protective barricades or beams.

b. Site plans need not be submitted for approval when increased storage capacity results from changes in storage criteria and has no effect on the established quantity distances.

c. Initial submission of site plans will be concurrent with the conceptual design review. Final safety approval can be obtained no later than the 60% design review process.

d. A site plan requirements package must contain the following basic information:
   1. Distances between the facility to be constructed/modified and other installations; the installation boundaries; underground pipelines; public traffic routes; and power transmission/utility lines. The distances may be listed in narrative form or reference may be made to the scaled drawing/facility map on which the specific distances are designated or clearly shown.
   2. Identification and brief description of the mission of all facilities within inhabited building distance of the facilities to be constructed/modified.
   3. General description of the components, items, and hazardous materials to be handled or stored in the new/modified facilities, to include explosives limits and hazard classifications.
   4. Anticipated personnel capacity of the facilities to be constructed/modified.
   5. Data pertaining to walls, roofs, shields, barricades, windows, exits, floors, explosives operating equipment, fire protection systems, lightning protection and static electricity grounding systems, electrical installations, ventilation systems and equipment, hazardous waste disposal systems, auxiliary support structures, monitoring equipment, general materials, and construction.

6. Explanation and rationale or justification for any variance from the requirements of this manual or any other NASA/SSC manual.
7. Test results and other substantiating documentation supporting in process hazard classifications.

e. All site plan requirements packages will be filed in the Central Engineering Files (CEF), after obtaining approval from the NASA/SSC Office of Safety and Mission Assurance.

f. A master drawing/map, indicating all quality distance (QD) limits for SSC, will be maintained and updated by the Facilities Operating Services Contractor (FOSC).

g. It is the responsibility of the cognizant NASA/SSC project manager/director to ensure that all QD limits for new or modified facilities are added to the SSC master QD drawing/map.

## Appendix C – Stennis Space Center Scaffold Inspection Tool

This tool can be used by the competent person to verify the safe working condition of scaffolds erected by offsite contractors working at SSC under a contract to NASA or to one of NASA's onsite contractors. The tool is intended to be used for the pre-shift as well as the for the erector's inspection.

| 1926.451 GENERAL REQUIREMENTS FOR ANY SCAFFOLD | YES | NO |
|---|---|---|
| **The following questions are from subpart A 1926.451 (a)** | | |
| Has the scaffold been constructed to maintain a safety factor of 4-to-1 (a1) | | |
| Has the scaffold been designed by a qualified person? (a6) | | |
| **The following questions are from subpart B 1926.451 (b)** | **YES** | **NO** |
| Has the scaffold platform been fully planked with less than 1" between planks or between planks and uprights? (b1i) | | |
| Are all platforms at least eighteen (18) inches wide? (b2) | | |
| Are platforms that are less than eighteen (18) inches protected by guardrail systems or will all employees have personal fall arrest systems? (b2ii) | | |
| Are open sides of scaffold less than fourteen (14) inches from the face of the work? (b3) | | |
| Where open sides of scaffolds are more than fourteen (14) inches, will fall protection systems be used by all employees? (b3) | | |
| For scaffolds that will be used for lathing and plastering is the platform less than eighteen (18) inches from the face of the work? (b3ii) | | |
| Are all platforms of ten (10) feet or less extending over their end supports no more than twelve (12) inches? (b5i) | | |
| Where platforms of ten (10) feet or less extend more than twelve (12) inches have guardrails been installed to block access to the overhang? (b5i) | | |
| Are platforms of ten (10) feet or more extending over their end supports no more than eighteen (18) inches? (b5ii) | | |
| Where platforms of ten (10) feet or more extend more than eighteen (18) inches have guardrails been installed to block access to the overhang? (b5i) | | |
| Are abutted planks resting on separate support surfaces? (b6) | | |
| Where planks are overlapped are they lapped over the supports? (b7) | | |
| Are planks overlapped at least twelve (12) inches, nailed together or otherwise secured? (b7) | | |
| Are planks that rest on the bearer at other than a ninety (90) degree angle laid first? (b8) | | |
| Are the top and bottom surfaces of the plank visible and free from paint and other opaque finishes? (b9) | | |

| | | |
|---|---|---|
| If scaffold components of different manufacturers are used, do they fit together without force and has a competent person determined that they are safe for use? (b10) | | |
| Has the use of dissimilar metals (if any) been evaluated by a competent person? (b11) | | |
| **The following questions are from subpart C 1926.451 (c)** | **YES** | **NO** |
| Does the scaffold conform to the 4-to-1 base to height ratio requirement? (c1) | | |
| Scaffolds that do not meet the 4-to-1 base to height ratio must be secured to the structure by use of ties (to include ties, guying, bracing or equivalent means) as follows: | | |
| Has the tie been installed at a horizontal member that supports the inner and outer legs? (c1i) | | |
| Has the first vertical tie been installed at a height less than four (4) times the minimum base dimension? (c1ii) | | |
| Have vertical ties been repeated every twenty (20) feet or less for scaffolds that are 3 feet or less in width? (c1ii) | | |
| Have vertical ties been repeated every twenty-six (26) feet or less for scaffolds wider than three (3) feet? (c1ii) | | |
| Is the vertical distance from the top tie to the top of the scaffold less than the 4-to-1 minimum base dimension? (c1ii) | | |
| Are ties installed at each end of the scaffold and at horizontal distances not to exceed thirty (30) feet? (c1ii) | | |
| Where eccentric loads are imposed have ties been installed to counteract these loads? (c1iii) | | |
| Are scaffolds erected on adequate firm footings? (c2) | | |
| Are footings capable of supporting four (4) times the intended load without settling? (c2i) | | |
| Is the use of unstable objects prohibited for footings? (c2ii) | | |
| Is scaffold plumb and braced to prevent swaying or displacement? (c3) | | |
| **The following questions are from subpart E 1926.451 (e)** | | |
| ***The following questions apply to access from 1926.451 (e)*** | **YES** | **NO** |
| Has safe access been provided for all scaffold platforms that are more than two (2) feet above or below the point of access? (e1) | | |
| Have cross braces been prohibited as a means of access? (e1) | | |
| If used; do portable ladders (i.e. extension or free-standing) meet the specific requirements of 1926 subpart X) | | |
| Are ladders positioned so as not to tip the scaffold? (e2i) | | |
| Is the bottom rung less than twenty-four (24) inches above the supporting surface? (e2ii) | | |

| | | |
|---|---|---|
| Are rest platforms installed every thirty-five (35) feet vertically? (e2iii) | | |
| ***The following applies to hook on and attachable ladders from 1926.451 (e)*** | **YES** | **NO** |
| Are the ladders specifically designed for use with the type of scaffold used? (e2iv) | | |
| Do the ladders have a minimum rung length of 11½ inches? (e2v) | | |
| Is the rung spacing uniform and no more than 16¾ inches between rungs? (e2vi) | | |
| ***The following applies to ladder rungs built into the frame from 1926.451 (e)*** | ***YES*** | ***NO*** |
| *Integral prefabricated scaffold access frames shall conform to the following:* | | |
| Was the frame e designed and built to be used as an access ladder? (e6i) | | |
| Are the rungs at least eight (8) inches in length? (e6ii) | | |
| Are rungs uniformly spaced within each frame section? (e6iv) | | |
| Are rest platforms provided every thirty-five (35) feet? (e6v) | | |
| Is the distance between the rungs less than 16 ¾ inches? (e6vi) | | |
| Do rungs and steps of ladders line up vertically between the rest decks? (e7) | | |
| Is direct access from other structures prohibited when that distance is more than 24 inches vertically or fourteen (14) inches horizontally? (e8) | | |
| **The following applies to scaffold use from 126.451 (f)** | **YES** | **NO** |
| Are scaffolds and components loaded within their rated capacities? (f1) | | |
| Is the use of shore or lean to scaffolds prohibited? (f2) | | |
| Has the scaffold been inspected by a competent person as required? (f3) | | |
| Has any damaged part of the scaffold been repaired, replaced or removed as required? (f4) | | |
| Has the movement of occupied scaffolds been prohibited? (unless designed by a registered professional engineer) (f5) | | |
| Do scaffolds and any conductive material handled on them observe the proper clearances from power lines? (f6) refer to distances as shown in 1925.451 (f) (6) | | |
| Are slippery conditions removed as soon as possible? (f8) | | |
| Are tag lines used to control loads being hoisted onto or near scaffolds? (f9) | | |
| If storms or high winds are present has a competent person been consulted and wind screens or personal fall arrest used? (f12) Note: If winds are steady at eighteen (18) knots or gusts of twenty-two (22) knots or more, no erection or work on floats, spiders, or scaffolds is allowed at SSC | | |
| Are tools, material, and debris removed from scaffold to prevent an accumulation? (f3) | | |
| Has the use of makeshift devices to increase the working level height been prohibited? (f14) | | |

| | | |
|---|---|---|
| Are ladders on top of scaffold decks prohibited? (f15) check 1926.451 (f) (15) (I, ii, iii, and iv) for criteria that will allow for ladders on scaffold decks. | | |
| Have provisions to prevent platforms from deflecting more than 1/60$^{th}$ of the span been made? (f16) | | |
| **The following applies to fall protection from 1926.451 (g)** | **YES** | **NO** |
| Are guardrails used on all scaffolds over six (6) feet in height? | | |
| Are personal fall arrest systems used where guardrails are not feasible? | | |
| Are guardrails and mid-rails installed on all open sides (more than fourteen (14) inches from the work surface)? | | |
| Are guardrails installed at thirty eight (38) to forty-five (45) inches in height? (g4ii) | | |
| When mesh or screens are installed do they extend from the top of the guardrail to the platform? (g4v) | | |
| Will the guardrails withstand two hundred (200) pounds in a downward or outward direction? | | |
| **The following applies to falling object protection 1926.451 (h)** | **YES** | **NO** |
| Have falling object hazards been eliminated according to 1926.451 (h) | | |
| Have toe boards been installed to prevent falling objects? (h2ii) | | |
| Where required, have screens been installed to protect employees from falling objects? (h2iii) | | |
| Are toe boards at least 3½ inches in height? (h4ii) | | |
| **1926.452 SCAFFOLDS** | | |
| **The following applies to tube and coupler scaffolds from 1926.452 (b)** | **YES** | **NO** |
| Is "X" bracing installed on the ends of the scaffold and every third set of posts horizontally and every fourth runner vertical? (b2) | | |
| Are ties installed at the bearer level? (b2) | | |
| Is longitudinal bracing installed at a forty-five (45) degree angle on both faces of the scaffold? (b3) | | |
| Does the longitudinal bracing extend from the first (left hand) post to the extreme top of the scaffold? (b3) | | |
| If the scaffold is longer than five posts, is a new line of bracing begun at every fifth post? (b3) | | |
| Is bracing installed as close as is possible to the node point? (b3) | | |
| Are the bearers attached to both posts and does the inboard coupler rest on the runner coupler? (b5) | | |
| Do the ends of the bearer tube have full contact within the clamp? (b6) | | |

| | | |
|---|---|---|
| Are runners installed on the inside and outside of the scaffold at level heights? (b7) | | |
| If outside runners are left out, are there midrails and guardrails above and below the point where the runner would have been? (b7) | | |
| Are runners interlocked and coupled to each post? (b8) | | |
| Do light and medium-duty scaffolds have posts, runners, bearers and braces of two (2) inches O.D. steel tubing? 1926 Subpart L Appendix A table (b) | | |
| Are posts on light-duty scaffolds spaced no more than four (4) feet apart by ten (10) feet) along the length of the scaffold?1926 Subpart L Appendix A table (b) | | |
| Are posts on medium-duty scaffolds spaced no more than four (4) feet apart by seven (7) feet along the length of the scaffold? 1926 Subpart L Appendix A table (b) | | |
| Is the maximum vertical runner spacing of 6'6"?Appendix A table (b) | | |
| If the maximum number of planked levels, working levels, or overall height exceed those shown in table b are drawings done by a registered professional engineer?1926 Subpart L Appendix A (2) table (b) | | |
| Has the use of side brackets and their impact on the overall scaffold been fully evaluated? (b5 i, ii, and iii) | | |
| Have scaffolds over one hundred and twenty-five (125) feet in height been constructed and loaded according to design of a registered professional engineer? (b6) | | |
| **The following applies to fabricated frame scaffolds from 1926.452 (c)** | **YES** | **NO** |
| Are frames secured by braces which secure the vertical members laterally?(c2) | | |
| Do the braces automatically square and align the frames? (c2) | | |
| Are all brace connections secured? (c2) | | |
| Are frames joined together by coupling pins or equivalent means? (c3) | | |
| Where uplift may occur are the frames locked together? (c4) | | |
| **The following applies to mobile scaffolds from 1926.452 (w)** | **YES** | **NO** |
| Are frames secured by braces which secure the vertical members laterally? (w1) | | |
| Do the braces automatically square and align the frames? (w1) | | |
| Are all brace connections secured? (w1) | | |
| Do scaffolds constructed of tube and clamps meet the requirements of that type of scaffold? (w1i) | | |
| Do scaffolds constructed of frame scaffolding meet the requirements of that type of scaffold?(w1ii) | | |
| Are casters locked during use? (w2) | | |
| Is the manual force used to move the scaffold applied as close to the base as possible? (w3) | | |

| | | |
|---|---|---|
| Are scaffolds stabilized to prevent tipping during movement? (w5) | | |
| Are casters pinned into the frames or adjustment screws? (w9) | | |

**NOTE 1:** The above tool was prepared for the most common scaffolds in use today. Separate tools or checklists would have to be developed in the event that one of the many other types of scaffolds was to be used on the job site. One of the various SSC safety offices should be consulted to help in developing such tools or checklists.

**NOTE 2:** SSC extends its appreciation to the Scaffold Training Institute for allowing our use of their copyrighted "Scaffold Inspection Form" in creating this tool Person(s) desiring to use this form should contact the Scaffold Training Institute of Houston Texas (Phone: 281-332-1613, Fax: 281-316-2030) for permission.