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KSC Industrial Hygiene Programs

**National Aeronautics and
Space Administration**

John F. Kennedy Space Center

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PREFACE

P.1 Purpose

It is KSC policy to provide employees with an environment in which occupational health hazards are identified, evaluated, and eliminated or controlled in such a manner that personnel do not suffer adverse health effects as a result of their employment. Activities shall be conducted in a manner that conforms to all applicable federal, state and local regulatory requirements. Personnel exposures to chemical and/or physical agents shall at all times be restricted to levels below regulated exposure limits and as low as reasonably achievable.

This KNPR provides direction for development, management, and implementation of the KSC Industrial Hygiene Program. Environmental Health and other operations organizations will supplement the provisions of this KNPR by implementation of internal policies and instructions as needed.

Additional requirements for the KSC Industrial Hygiene Program are contained within KNPD 1800.2, "KSC Hazard Communication Program"; KNPR 1820.4, "KSC Respiratory Protection Program," and KNPR 1820.3, "KSC Hearing Loss Prevention Program."

P.2 Applicability

This KNPR applies to all NASA organizational elements located at Kennedy Space Center (KSC), the United States Air Force (USAF) 45th Space Wing, and NASA/KSC facilities and operations at other locations. Organizational elements include associated contractors to the extent specified in their respective contracts; carrier and payload organizations; and other Government agencies, their contractors, and tenants.

P.3 Authority

- a. Title 29, Code of Federal Regulations, Part 1960.
- b. Executive Order 12196, "Occupational Safety and Health Programs for Federal Employees."
- c. NPD 1820.1 (as revised), "Environmental Health Program"
- d. NPR 8715.1 (as revised), "Safety and Health Handbook - Occupational Safety and Health Programs"

P.4 References

- a. Title 40, Code of Federal Regulations, Parts 60 - 80.
- b. Occupational Safety and Health Act of 1970.
- c. Privacy Act of 1974.
- d. NPR 8820.2 (as revised), "Design and Construction of Facilities"
- e. NPR 1800.1 (as revised), "NASA Occupational Health Program Procedures."
- f. NASA FAR Supplement 1823.70, "Safety and Health."
- g. KNPD 1800.2 (as revised), "KSC Hazard Communication Program."
- h. KNPD 1810.1 (as revised), "KSC Occupational Medicine Program."

- i. KHB 1700.7 (as revised), "Space Shuttle Payload Ground Safety Handbook."
- j. KNPR 8715.3 (as revised), " KSC Safety Practices Procedural Requirements "
- k. KNPR 1820.3 (as revised), "KSC Hearing Conservation Program."
- l. KNPR 1820.4 (as revised), "KSC Respiratory Protection Program."
- m. KNPR 8500.1 (as revised), "KSC Environmental Requirements"
- n. American Conference of Governmental Industrial Hygienists, "Threshold Limit Values for Chemical Substances and Physical Agents Biological Exposure Indices (as revised). "
- o. American Industrial Hygiene Association, "A Strategy for Occupational Exposure Assessment"
- p. American Conference of Governmental Industrial Hygienists Manual on Industrial Ventilation (as revised).
- q. American National Standards Institute (ANSI) Z9.2, Fundamentals Governing the Design and Operation of Local Exhaust Systems.
- r. National Institute for Occupational Safety and Health Criteria for a Recommended Standard: Working in Confined Spaces.
- s. National Institute for Occupational Safety and Health, "Occupational Exposure Sampling Strategy Manual"
- t. National Institute for Occupational Safety and Health, "Guide to Industrial Respiratory Protection"
- u. National Institute for Occupational Safety and Health, "Guide to Industrial Ventilation"
- v. National Institute for Occupational Safety and Health Manual of Analytical Methods (as revised).
- w. National Institute for Occupational Safety and Health, Recommendations for Chemical Protective Clothing *A Companion to the NIOSH Pocket Guide to Chemical Hazards*

P.5 Cancellation/Supersession

This document cancels and supersedes KNPR 1840.19, KSC Industrial Hygiene Program.

P.6 Definitions

- a. Action Level - The concentration or level at which the use of control measures becomes mandatory. The Action Level is used when variations of measured air contaminant levels can exceed the regulated level. Unless otherwise mandated by a specific regulatory or consensus standard, the "action level" is set at one-half of the exposure limit of the hazardous material.
- b. Airborne Contaminant - A substance (dust, fume, mist, vapor, or gas) whose presence in air is harmful, hazardous, or undesirable.
- c. American Conference of Governmental Industrial Hygienists (ACGIH) - A non-regulatory organization of industrial hygienists employed in the public sector. The organization develops and publishes Threshold Limit Values (TLVs) for chemical and physical agents.

- d. Asbestos Containing Building Material (ACBM) – Any material that contains greater than one percent asbestos by volume.
- e. Breathing Zone - The area within a two-foot radius of the employee's mouth or nose. The breathing zone sample represents the atmosphere to which the employee would inhale and be exposed to during normal working conditions.
- f. Corrosive - A chemical that causes visible destruction of or irreversible alterations in living tissue.
- g. Enclosure – An enclosure is a physical barrier is placed to contain a chemical or physical hazard to protect the occupants of the area.
- h. Engineering Control - Any design procedure that eliminates or controls exposure to chemical or physical hazards by substitution of less hazardous materials or processes or preventing the escape of hazardous materials or physical agents into the workplace.
- i. Entry - An action resulting in any part of the body breaking the plane of any of the confined space openings.
- j. Exposure – The process by which a chemical or physical agent enters the body through any route of entry including inhalation, ingestion, or absorption through the skin. Potential for exposure exists where air contaminants are present or where hazardous materials can come into contact with the skin.
- k. Fume - An aerosol consisting of minute solid particles arising from the volatilization from melted substances (such as molten metal).
- l. Gas - A formless fluid that occupies the space of its enclosure. It can be changed to its liquid or solid state only by increased pressure and decreased temperature.
- m. Hazardous Chemical or Hazardous Material - Chemicals or materials which are health hazards or physical hazards.
- n. Health Hazard - A health hazard is a chemical or physical agent where it is established that acute or chronic injury or illness may occur in exposed employees, based upon statistically significant evidence in at least one study conducted in accordance with scientific principles.
- o. Industrial Hygiene -The profession devoted to the prevention of occupational illness or disease associated with exposures to hazardous materials and physical agents.
- p. Laboratory Hood - An exhaust hood which partially encloses a contaminant producing operation.
- q. Material Safety Data Sheet (MSDS) - Technical information on chemical products published by the chemical manufacturer, formulator, or importer. The MSDS contains product name, ingredients, toxicity, physical and chemical

characteristics, fire and explosion data, health hazard information, and emergency and disposal procedures.

- r. Mist - Suspended liquid droplets generated by condensation from the gaseous to the liquid state or by dispersing a liquid, by splashing, foaming, or atomizing.
- s. National Voluntary Laboratory Accreditation Program (NVLAP) - A program administered by the United States Department of Commerce National Institute of Standards and Technology to accredit laboratories based on evaluation of their technical qualifications and competence.
- t. Occupational Safety and Health Administration (OSHA) - A United States Department of Labor regulatory and enforcement agency created for the implementation of the Occupational Safety and Health Act of 1970.
- u. Organization Industrial Hygiene Contact - An individual or individuals assigned by the head of a primary organization to represent the organization for industrial hygiene program matters.
- v. Permissible Exposure Limit (PEL) – The terminology used by OSHA for Time-Weighted Average concentration of a regulated air contaminant listed in 29 CFR 1910, Subpart Z.
- w. Physical Agent - Physical factors such as heat, ultraviolet and ionizing radiation, humidity, noise, magnetic fields, or abnormal pressure and the like which may constitute a health hazard.
- x. Physical Hazard - A chemical that is combustible, flammable, or explosive; is an oxidizer or organic peroxide; is a compressed gas; or is corrosive, pyrophoric, water-reactive, or otherwise unstable.
- y. Safety Representative - As used in this document, the cognizant safety representative is a fully qualified safety professional who works for either NASA or contractor safety organizations.
- z. Short-Term Exposure Limit (STEL) – A STEL is a 15-minute TWA exposure that should not be exceeded at any time during the workday even if the 8-hour TWA is not exceeded. STELs are published in the Threshold Limit Values for Chemical Substances and Physical Agents in the Work Environment for chemicals with short-term toxic effects.
- aa. Threshold Limit Value (TLV) - Established by the American Conference of Governmental Industrial Hygienists (ACGIH) and refer to airborne concentrations of substances and represent conditions under which it is believed that nearly all workers may be exposed day after day without adverse health effects.
- bb. Time-Weighted Average (TWA) - The average concentration of a contaminant in air during a specific time period be repeatedly exposed day after day without adverse effect. The TLVs are published periodically in the Threshold Limit Values for Chemical Substances and Physical Agents in the Work Environment.

- cc. User - An individual who possesses and/or uses hazardous materials and physical agents.
- dd. Vapor - The gaseous state of a substance that is solid or liquid at ordinary temperature and pressure.

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PROCEDURES

Chapter 1. INDUSTRIAL HYGIENE FUNCTIONAL RESPONSIBILITIES

1.1 Goal

The goal of the Industrial Hygiene Programs procedural requirements is to provide a uniform approach for implementing Centerwide compliance with applicable Occupational Safety and Health Administration (OSHA) regulations, NASA Agency Occupational Health Program policy, and local KSC policy for the recognition, evaluation, and elimination or control of workplace health hazards.

1.2 Objective

The objective of Industrial Hygiene Programs procedural requirements is to document Center policy and implementing guidelines and to enable KSC civil service and contractor organizations to effectively use available Industrial Hygiene program resources to protect employees, customers, and the public.

1.3 Heads of Organizations

Heads of Primary Organizations and Heads of Contractor Organizations to the extent provided by their contracts will:

- a. Prepare written policies and procedures when required to implement Industrial Hygiene Program requirements and identify and assign Industrial Hygiene Program responsibilities within the organization.
- b. Develop and maintain written procedures for operations and equipment involving the use, exposure to, generation of, or control of occupational health hazards.
- c. Ensure assessment plans, processes, and operations are reviewed to implement and maintain control measures required to prevent or otherwise reduce exposure to these hazards.
- d. Ensure personnel:
 - (1) Are provided appropriate training and orientation to identify occupational health hazards in their work places and the protective measures required for their safety.
 - (2) Are notified of any changes or modifications to policies or systems used to control exposure to these hazards.
- e. Comply with the provisions of NASA FAR Supplement 1823.70 for procurement requests and statements of work issued (involving Industrial Hygiene Program concerns).

- f. Ensure Material Safety Data Sheets (MSDS) are provided to the JBOSC MSDS Program Coordinator.
- g. Designate Organizational Industrial Hygiene Contacts (OIHC) to act as organization points of contact for Industrial Hygiene Program business.
- h. Ensure that any mishap, close call, or injury or illness that involves occupational health hazards is properly reported to the NASA IRIS reporting system.
- i. Review design and modification packages for systems involving the use, storage or processing of hazardous materials or which have the potential to expose employees to hazardous materials or physical agents to identify required hazard controls.
- j. Communicate operational hazards to other employers whose employees may be affected by the hazards.
- k. Ensure that results of health hazard evaluations are provided to affected employees.

1.4 The KSC Industrial Hygiene Officer (IHO) will:

- a. Act as liaison between KSC and federal and/or state regulatory agencies on industrial hygiene matters.
- b. Provide technical guidance to KSC organizations on industrial hygiene matters.
- c. Review and assess the use of toxic/hazardous substances.
- d. Develop industrial hygiene policies, requirements, and general practices for KSC.
- e. Assist and advise the Procurement Officer in implementing the requirements of NASA FAR Supplement 1823.70 as it applies to the acquisition of toxic/hazardous substances.
- f. Assist safety and operations organizations in the investigation of accidents, incidents, near misses, and injuries/illnesses that involve hazardous chemical or physical agents.
- g. Monitor the implementation of this KNPR.

1.5 The JBOSC Industrial Hygiene Office will:

- a. Provide Health Hazard Evaluations of operations, tasks, or procedures, with the potential to expose employees to occupational health hazards as described in this KNPR.
- b. Perform an annual inspection of each NASA facility and identify potential health hazards.

- c. Review and assess the use of personal protective equipment used to prevent exposure to occupational health hazards.
- d. Provide to OIHC's, supervisors, site managers, or responsible safety organizations in the affected work area the:
 - (1) Results of surveys and recommendations.
 - (2) Recommended methods for the elimination or control of occupational health hazards.
 - (3) Requirements for employees to participate in medical monitoring program.
 - (4) Recommendations on the management of Musculoskeletal Disorder (MSD)-related risk factors.
 - (5) Identified requirements for compliance with applicable OSHA regulations.
- e. Investigate report of occupational exposures to health hazards reported through the OHF.
- f. Evaluate employee complaints of potential health hazards.
- g. Review facility plans, projects and operational procedures to assess the adequacy of precautions taken to control hazards.
- h. Provide technical assistance in the selection and design of engineering controls and work practices, and selection of Personal Protective Equipment (PPE).
- i. Provide custody and maintenance of industrial hygiene records for NASA employees employed at KSC, in accordance with the requirements of 29 CFR 1910.1020.
- j. Provide technical assistance in the development of training/certification courses relating to industrial hygiene matters.
- k. Maintain a listing of hazardous materials and provide Centerwide access to Material Safety Data Sheet (MSDS) for each hazardous material reported in accordance with KNPD 1800.2.

1.6 Organization Industrial Hygiene Contacts (OIHC), will:

- a. Act as the organization point of contact(s) for the KSC IHO and the JBOSC Industrial Hygiene Office (IH).
- b. Represent their organization on committees and panels established by the KSC IHO.
- c. Monitor the implementation of the requirements of this KNPR in their areas.

- d. Track implementation of corrective actions to eliminate or control hazards or correct program discrepancies.

1.7 Civil Service and Contractor Line Management will:

- a. Ensure workplace inspections are conducted and operations/procedures are reviewed to identify hazardous materials and physical agents.
- b. Ensure MSDS for materials used in the workplace are reviewed to identify health hazards, symptoms of exposure, and requirements for safe use of the material.
- c. Ensure written procedures are in place for operations that require use of hazardous materials and physical agents. Written procedures must identify the hazards and include instruction on use of required engineering and work practice controls, and required PPE.
- d. Ensure his/her employees are aware of hazardous materials and physical agents in the work area, understand the requirements for safe work with these materials and agents, and know what actions to take in an emergency (e.g. chemical spill or release).
- e. Contact the OIHC to determine requirements for work in the following categories:
 - (1) Work with hazardous chemicals.
 - (2) Construction or demolition where asbestos or lead-containing paints may be present.
 - (3) Work in confined spaces.
 - (4) Work involving employee exposure to excessive heat, vibration, or noise.
 - (5) Potential ergonomic hazards.
- f. Coordinate the scheduling of Health Hazard Evaluations
- g. Implement requirements identified in the Health Hazard Evaluation.
- h. Ensure affected employees are provided results of Health Hazard Evaluation reports. Where reports include employee exposure monitoring data, provide the employees who are monitored with their exposure monitoring results.
- i. Contact the KSC Industrial Hygiene Officer or the OIHC when operation or process changes are made which may affect exposure levels.
- j. Ensure the proper operation of engineering controls.
- k. Ensure employees with signs or symptoms of exposure report to the Occupational Health Facility.

1.8 Cognizant safety representative will:

- a. Inspect the workplace for potential hazards and exposures. Contact the OIHC to initiate health hazard evaluations of operations in which hazards are identified.

(If an employee has symptoms of exposure to hazardous materials, direct the employee to the Occupational Health Facility.)

- b. Inspect work areas to ensure implementation of hazard control measures as required by OSHA or NASA regulation or otherwise required to control or eliminate employee exposure.
- c. Coordinate with the KSC Industrial Hygiene Officer or the OIHC in instances of deviations or waivers to Technical Operating Procedures affecting health hazard control requirements.

1.9 Employees will:

- a. Notify supervisors of areas, operations, or equipment that may be a source of chemical or physical hazards.
- b. Report signs and symptoms of exposure to the supervisor and the Occupational Health Facility.
- c. Use, maintain, and store PPE as required.

Chapter 2. GENERAL PROVISIONS

2.1 Applicable Exposure Limits

- a. NASA has adopted health standards promulgated by the Occupational Safety and Health Administration (OSHA) or recommended by the American Conference of Governmental Industrial Hygienists (ACGIH), whichever is more stringent. Additionally, NASA Headquarters may issue NASA health policy to address exposure limits.
- b. In the absence of a specific OSHA, ACGIH, or NASA standard, other sources of health standards or exposure limits which may be selected by the KSC IHO to include National Institute for Occupational Safety and Health (NIOSH) Criteria Documents, American National Standards Institute (ANSI) standards, National Academy of Sciences recommendations, American Industrial Hygiene Association exposure guidelines, or chemical manufacturer exposure limits.
- c. Management policies and programs will be developed to ensure employee exposures to such materials or agents are below the applicable exposure limit(s). In addition, policies and programs will include implementing appropriate control measures when exposure levels exceed the "Action Level" for the hazardous material or agent of concern.

2.2 Initial Hazard Assessment

- a. An initial hazard assessment will be initiated whenever a potential hazard is identified as a result of:
 - (1) Inspection of workplaces for potential health hazards.
 - (2) Review of procedures or operations to identify hazardous materials or physical agents.
 - (3) Investigation of complaints of illness or injury that may be work-related.
 - (4) Employee reports of potential health hazards.
- b. The organizations line management, OIHC, safety committee, or Safety Representative, shall typically conduct this assessment.
- c. The initial assessment shall involve identification and preliminary evaluation to gather data in support of the Health Hazard Evaluation (HHE) that will be conducted by the JBOSC Industrial Hygiene Contractor.
- d. Once the potential health hazard is identified by or reported to the OIHC or Safety Representative, an initial assessment shall be performed.
- e. The initial assessment shall be a semiformal process aimed at gathering data to:

- (1) Support the HHE
 - (2) Control hazards in the interim
 - (3) Eliminate the hazard and the need for further HHE
- f. The initial assessment consists of the following elements where applicable
- (1) Identification of the processes involved
 - (2) Gathering information (e.g. review MSDSs) on the materials (chemicals)
 - (3) Description of the health hazard(s) present
 - (4) Identification of the controls in place
 - (5) Identification of any PPE in use
 - (6) Description of exposure routes
 - (7) Identification of exposure groups
- g. A Health Hazard Evaluation (HHE) should be conducted where there is a reasonable potential for employee exposure to the hazardous material or condition. The OIHC or Safety representative may consult with the NASA IHO or the JBOSC IHO to determine the need for a HHE. If it is determined that a HHE is required, it is the responsibility of the line management organization to coordinate the HHE with the JBOSC IHO through the OIHC or Safety representative and provide the information gathered during the initial assessment.

2.3 Health Hazard Evaluation

- a. Health hazard evaluations shall be performed to evaluate and document employee exposures to hazardous materials or physical agents. HHEs shall comply with the minimum requirements established below.
- b. Health hazard evaluation sampling strategy shall be developed in accordance with recognized industrial hygiene practice, e.g. use of NIOSH's Occupational Exposure Sampling Strategy manual or AIHA's "A Strategy for Occupational Exposure Assessment," to provide exposure data. Personnel breathing zone measurements based on the applicable exposure limit (e.g., 8-hour Time Weighted Average or 15-minute TWA) shall be performed and documented using the sampling strategy.
- c. When possible, employee exposure monitoring should characterize exposure for similarly exposed work groups. Representative exposure data for similarly exposed personnel will be made available for incorporation in employee medical records.
- d. All employees monitored for exposure level shall be informed of their legal rights to their exposure records (29 CFR 1910.1020, "Access to Employee Exposure and Medical records").
- e. Exposure monitoring results shall be compared to the applicable exposure standard to determine compliance.
- f. Health hazard evaluations shall represent the operations as they are typically performed.

- g. Follow up health hazard evaluations shall be performed:
 - (1) to assess conditions after any modifications which may increase the potential for employee exposure or the implementation of hazard control measures are completed; or
 - (2) at intervals specified in substance specific standards identified in 29 CFR 1910 and 1926.
- h. The name and Social Security Number of all employees monitored as well as those other employees in the work unit with similar exposures shall be recorded during the health hazard evaluation.
- i. When possible, samples representing the worst case employee exposure should be collected.
- j. Sampling Requirements
 - (1) All industrial hygiene sampling shall be performed in accordance with the NIOSH or OSHA methodologies. The KSC Industrial Hygiene Officer shall concur with the selection of alternate sampling methodologies if no NIOSH or OSHA methodology exists.
 - (2) Sampling equipment shall be operated according to the manufacturer's specifications.
 - (3) Sampling pumps shall be calibrated before and after sampling usage to verify the flow rate is within sampling specifications.
 - (4) After the completion of sampling, all samples shall be properly stored in appropriate containers and uniquely labeled.
 - (5) Field and lot blanks shall be taken in accordance with NIOSH sampling procedures.
 - (6) Bulk samples shall be collected in accordance with the analytical laboratory requirements.
 - (7) Sampling data shall be recorded on a sampling data sheet that includes the following, as applicable:
 - (a) Sample identification.
 - (b) Employee names and social security numbers. (*Note: All records in which an employee's Social Security number is included shall be covered with NASA Form 1534, in accordance with the Privacy Act of 1974.*)
 - (c) Description and location of task being performed.
 - (d) Monitoring instrument manufacturer, model, identification number, and calibration date.
 - (e) Pump pre-calibration, post-calibration and average flow rate.
 - (f) Sample date, start time and stop time.

- (g) Description of personal protective equipment used.
- (h) Description of factors that may affect sampling (e.g., ventilation system, weather data).
- (i) Facility number, name and room number.
- (j) Contaminant or agent being sampled.
- (k) Sampling method used.
- (l) Contact name and organization.
- (m) Name of individual performing the sampling.

(8) When samples are obtained for laboratory analysis, a sample chain-of-custody document shall accompany all samples. The custody of the samples during the time period from sampling to laboratory receipt of samples must be recorded on the document.

k. Analysis Requirements

- (1) Laboratories performing industrial hygiene sample analysis shall be accredited by the American Industrial Hygiene Association (AIHA) except for the following:
 - (a) A laboratory accredited by the National Voluntary Laboratory Accreditation Program (NVLAP) shall perform bulk asbestos sample analysis.
 - (b) Airborne fiber sampling and analytical procedures shall be by Phase Contrast Microscopy (PCM) in accordance with the most current version of the NIOSH 94-113, Method 7400.
 - (c) Analysis shall be performed in accordance with OSHA analytical methods, NIOSH analytical methods, or, in their absence, documented standard laboratory analysis procedures.
- (2) The laboratory analysis results shall be reported on a document to include the following:
 - (a) Laboratory name, address, phone number.
 - (b) AIHA certification number or NVLAP accreditation number.
 - (c) Sample number
 - (d) Sampling date and time
 - (e) Sample matrix
 - (f) Parameter name and CAS #
 - (g) Date samples received.
 - (h) Date samples analyzed.
 - (i) Signature of laboratory manager.
 - (j) Name of analyst.
 - (k) Lab report identification and task identification number.
 - (l) Analysis method and reference (e.g OSHA or NIOSH reference), reporting limit, and limit of detection of the method.
 - (m) Units of measure
 - (n) Itemized results for each sample number.

l. Report Requirements

- (1) Upon the completion of health hazard evaluations, a report of the findings shall be issued. The following information shall be included in the report:

- (a) Name and organization of the person requesting the evaluation.
 - (b) A description of the reason for the evaluation.
 - (c) The location (facility name and number), date and time of sampling performed.
 - (d) Any observations, including photographs, of operations, employees work practices, or other actions that may contribute to employee exposure.
 - (e) The name, number, and description of the procedure for which the health hazard evaluation was made.
 - (f) The names and quantities of the hazardous materials used which are evaluated in the report. Manufacturer and product names will be used when available. Where chemical substances are identified the chemical names and CAS numbers will be listed.
 - (g) The job classifications and task description of all employees monitored.
 - (h) The frequency and duration of the operation evaluated.
 - (i) The environmental conditions at the time of the health hazard evaluation.
 - (j) All hazard control measures used, such as engineering controls or personal protective equipment.
 - (k) The name and social security number of employees for which exposure monitoring is performed and their determined exposure levels.
 - (l) The contract employer of personnel monitored.
 - (m) The sampling method and instrumentation used during the health hazard evaluation.
 - (n) Identification of applicable OSHA and NASA requirements for the substances monitored, nonconforming conditions, and recommended interim and permanent corrective actions.
- (2) All reports in which an employee's Social Security number is included shall be covered with NASA Form 1534, in accordance with the Privacy Act of 1974.
- (3) Copies of all HHEs shall be provided to the KSC Industrial Hygiene Officer.

2.4 Instrument Selection, Calibration, And Use

This section establishes procedures for the selection, calibration, and use of instruments utilized for monitoring of health hazards. Monitoring instruments are devices that can detect the presence of hazardous materials or physical agents and provide direct measurement of their presence.

a. Instrument Selection

- (1) Instruments will be selected based on the specific hazardous material or physical agent to be monitored and the applicable monitoring requirements.
- (2) User organizations will coordinate the selection and use of all real-time health hazards, monitoring equipment with the Organization Industrial Hygiene Contact (OIHC).
- (3) The OIHC shall provide to the JBOSC Industrial Hygiene Office the following information:
 - (a) The concentration range and physical state of the hazardous material or physical agent in the workplace. If the concentration range is unknown, an industrial hygiene health hazard evaluation should be performed. (Refer to Section 2.4)
 - (b) The manufacturer, model, and technical specifications of the instrument.
 - (c) The intended use of the monitoring instruments.
- (4) For hydrazine vapor detectors, the OIHC shall also coordinate the selection with the Applied Technology Directorate.
- (5) The JBOSC Industrial Hygiene (IH) Office will:
 - (a) Maintain a database of industrial hygiene monitoring instruments provided by the OIHCs.
 - (b) Provide consultation on the selection of industrial hygiene instrumentation.
- (6) The Engineering Development Directorate Instrumentation and Controls Branch will provide consultative services for the selection of industrial hygiene instrumentation for special applications to include:
 - (a) Preparation of qualification test procedures.
 - (b) Recommendation of laboratories to perform qualification tests.
 - (c) Analysis of laboratory data.
 - (d) Development of procurement specifications.
 - (e) Recommendations for field-testing.

b. Instrument Calibration

Instrument calibration shall be performed to verify the proper function of the instrument prior to use. The user organization shall ensure the following calibration procedures are performed:

- (1) Instrument calibration shall be performed in accordance with the manufacturer's instructions or as otherwise specified by the calibration lab.
- (2) The manuals and calibration procedures for the instrument shall be provided to the organization's calibration laboratory.
- (3) The organization's calibration laboratory or the instrument manufacturer shall calibrate the instrument. A calibration sticker with an expiration date shall be affixed to the instrument by the calibrating organization.
- (4) The calibration cycle shall be determined by the manufacturer's recommendations, the organization's calibration laboratory.
- (5) Calibration records shall be maintained by the organization's calibration laboratory and the user organization.

c. Instrument Use

- (1) Monitoring instruments shall be used in accordance with the manufacturer's instructions. The user organization shall ensure the following:
 - (2) Operators are trained and qualified to properly operate the monitoring instruments. Operator training shall be documented in an auditable format.
 - (3) Instruments shall not be used beyond the calibration expiration date.
 - (4) The user shall perform a functional check of the instrument prior to each use in accordance with manufacturer's instructions.

2.5 Health Hazard Controls

Hazard controls are the methods used to eliminate or reduce personnel exposure to hazardous agents. Exposures to hazardous chemicals or agents in the workplace are controlled by the application of one or more of the methods listed below. Hazard controls should be directed first toward eliminating the source of the hazard, second toward the route or path the potential hazard takes, and third toward shielding or protecting specific personnel who may be subject to exposure to the hazard.

a. General Provisions

- (1) Engineering Controls - The primary method of health hazard control will be through the application of engineering controls. Engineering controls include, but are not limited to, the following:
 - (a) Substitution to a less hazardous agent or process.
 - (b) Isolation or enclosure of an operation or process.
 - (c) Ventilation and air cleaning to remove or reduce air contaminant levels.
- (2) Work Practices and Administrative Controls - When workplace health hazards cannot be sufficiently reduced or eliminated by engineering control methods alone, administrative controls must be established. This includes work

schedules, procedures, and practices which, when used in conjunction with engineering controls, will minimize worker exposure to hazardous agents. Administrative control measures include:

- (a) The use of modified work schedules, medical removal, work limitations, or frequent rest periods to minimize worker exposures.
 - (b) The use of alternate work procedures that reduce exposures.
 - (c) Implementation of access controls or clear areas to limit the number of personnel with access to a hazardous location.
- (3) Personal Protective Equipment (PPE) - PPE is used only when the combination of engineering and administrative control methods are not feasible or insufficient to reduce the hazard to safe levels; or as interim control measures. The use of PPE will not be considered a substitute for engineering or administrative controls. PPE is intended to shield individual workers from hazardous environments that cannot be reduced or eliminated by any other control methods. PPE includes:
- (a) Eye and face protection such as safety glasses, goggles or face shields.
 - (b) Hearing protection (e.g., ear plugs, ear muffs).
 - (c) Protective clothing; such as, gloves, aprons, boots, and coveralls.
 - (d) Protective creams and lotions to minimize skin contact to irritant chemicals.
 - (e) Respiratory protection.

2.6 Personal Protective Equipment (PPE)

This section establishes procedures for the selection, use, and maintenance of PPE. PPE is used as a protective barrier between an individual employee and hazardous materials or agents. PPE is required when other health hazard controls, such as engineering controls, have been shown to be infeasible or inadequate in eliminating or controlling the health hazard. PPE requirements for SCAPE operations are not addressed in this KNPR but may be found in KNPR 8715.3 'KSC Safety Practices Procedural Requirements'.

a. Selection

- (1) The use of PPE is based on the specific health hazards present, the type of operation to be performed, and the level of protection provided by the PPE. The PPE selected must provide adequate protection for the employee while enabling the employee to perform the operation. PPE shall be selected and used in accordance with 29 CFR 1910 subpart I - Personal Protective Equipment.
- (2) PPE requirements for operations will be determined based upon health hazard evaluation.
- (3) The PPE requirements shall be incorporated into the written technical operation procedure or other applicable shop instructions.
- (4) The PPE selection will be reviewed when changes in procedures or exposure hazards might alter its effectiveness.

- (5) Guidelines for selection of specific PPE for chemical protection may be found in **Recommendations for Chemical Protective Clothing - A Companion to the *NIOSH Pocket Guide to Chemical Hazards*** at <http://www.cdc.gov/niosh/ncpc/ncpc2.html>

(6) Recommended PPE for common operations are listed in the following table:

EYE AND FACE PROTECTION	
Hazards to Consider	Required PPE
Splash/splatter/spray of chemicals or biological materials; cryogenic liquids	Chemical goggles or safety glasses with side shields covered by a full-face shield.
High pressure cleaning or spraying	Safety glasses with side shields or safety glasses covered by a full-face shield.
Grinding/drilling – any flying particles or projectiles	Goggles or safety glasses with side shields.
Power tools (air or electrical)	Safety glasses with side shields.
Typical laboratory – chemical splash	Chemical goggles or safety glasses with side shields covered by a full-face shield.
Acetylene welding, cutting, burning, molten metals	Cutting goggles with appropriate filter lens numbers.
Arc Welding and cutting	Safety glasses with side shields and welding hood with appropriate filter lens numbers
Chipping, grinding or machining – flying particles	Goggles, safety glasses with side shields or face shield (face shield required for heavy grinding)
HAND AND ARM PROTECTION	
Hazards to Consider	Required PPE
Skin exposure to solvents, pesticides, acids, caustic or corrosive liquids, other chemicals	Chemical resistant gloves. See note.
Handle tools or materials likely to cause scrapes, cuts or bruises	Metal mesh, leather, canvas, Kevlar material or cloth gloves.
Skin contact with hot surfaces	Oven mitts, Leather or aluminized gloves, arm protection
Cryogenic liquids, skin contact with cold surfaces	Cryogen mitts, leather gloves
Exposure to exposed high voltage electrical wiring, etc	Electrical insulating rubber gloves per electrical safety specifications.
FOOT, LEG AND BODY PROTECTION	
Hazards to Consider	Required PPE
Hazards to feet related to sharp or heavy objects/equipment	Metatarsal guards, toe guards, combination foot-toe guards, safety shoes.
Splash/splatter/spray of chemicals or biological materials	Nomex coveralls, Tyvek garment, rubberized apron, chemical splash garment, chemical resistant boots. See note.
Cryogenic materials, flammable liquids/gases	Nomex coveralls
High voltage	Safety shoes
HEAD PROTECTION	
Hazards to Consider	Required PPE
Work under elevated work platforms, suspended loads or low overhead clearance	Hard hats
HEARING PROTECTION	
Hazards to Consider	Required PPE
Exposed to loud noise from machines, tools, etc.	Ear muffs and/or ear plugs with sufficient noise reduction rating to lower exposure below 85 dBA. See note.

RESPIRATORY PROTECTION	
Hazards to Consider	Required PPE
Exposure to dusts, fumes, mists, gases, vapors, smoke.	Half face or full face air-purifying respirator; Self-Contained Breathing Apparatus; Supplied-Air Respirator. <i>See note.</i>

Note: Selection of chemical resistant gloves, chemical protective clothing, hearing protection, and respiratory protection devices should be coordinated with the JBOSC Environmental Health through the Organization Industrial Hygiene Contact (OIHC)

b. Use and Maintenance of PPE

- (1) PPE shall be used and maintained in accordance with manufacturers' instructions.
- (2) PPE shall be used when required by the operational procedure or applicable shop instruction.
- (3) Personnel shall be trained on the use and maintenance of PPE.
- (4) Maintenance and repair of respiratory protection is specified in KNPR 1820.4.

c. Decontamination of PPE

- (1) All reusable protective clothing may require thorough cleaning or decontamination before the PPE can be reused. Requirements for decontamination or cleaning will be in accordance with the manufacturer's recommendation or as determined by the OIHC.
- (2) Contaminated disposable PPE such as splash suits, gloves, booties, etc., should be disposed of as hazardous waste where designated as such by the Waste Management Authority, as defined in KNPR 8500.1.

d. Inspection of PPE

- (1) Inspection of PPE shall be performed in accordance with manufacturer's instruction to ensure the integrity of the equipment.
- (2) Protective clothing and gloves shall be inspected (prior to use) for leaks, imperfect seams, non uniform coating, tears, cracks, pinholes, deterioration, etc.

e. Storage of PPE

Personal Protective Equipment shall be stored in a manner to prevent PPE from damage, dust, sunlight, chemical contamination, or extreme temperatures.

2.7 Training

Appropriate training shall be provided to personnel who may be exposed to hazardous materials or physical agents, to the supervisors of such personnel, and to personnel who implement the provisions of the KSC Industrial Hygiene Program.

- a. Employees shall be trained to recognize potential health hazards and the means to protect themselves from such hazards in their workplace. This training shall include:
 - (1) Hazard Communication Training (29 CFR 1910.1200).
 - (2) Instruction on the proper use and care of PPE (29 CFR 1910.132).
 - (3) Instruction on the proper use of engineering controls.
 - (4) Instruction on the proper procedures to be implemented during spills or accidents that involve hazardous material, including emergency notification.

- b. Supervisors - Training for management representatives supervising operations involving health hazards should include:
 - (1) Regulatory and KSC requirements for health hazard control measures.
 - (2) Identification of potential health hazards and how to request a health hazard evaluation.
 - (3) Procedures for reporting employee exposures, and accidents involving hazardous materials.

- c. Safety Representatives or other employees delegated safety responsibility, as defined in this KNPR, shall be capable of performing the functions of their assigned areas of responsibility. Examples include:
 - (1) Identification of health hazards in the work area and recognition of potential exposures.
 - (2) Procedures for requesting an industrial hygiene evaluation for potential hazards that are identified.
 - (3) Procedures for reporting employee exposures, mishaps, and accidents involving hazardous materials.
 - (4) Use and care of required PPE.
 - (5) Use and care of monitoring equipment, as required.

- d. Industrial Hygiene Personnel or other employees' delegated with Industrial Hygiene responsibility shall be competent in their assigned areas of responsibility. Industrial Hygiene personnel should be knowledgeable of applicable Federal and NASA health hazard regulations and requirements and be able to recognize, evaluate, and control health hazards using standard industrial hygiene procedures.

- e. All formal training programs that include information on hazardous materials, health hazard identification, Hazard Communication Training, and PPE use shall be reviewed by the organization safety and health program. Written comments concerning the information in the training course will be provided to the training organization for incorporation.

2.8 Records

- a. Industrial Hygiene records are maintained to document employee exposure, for future epidemiology studies, regulatory compliance verification, and exposure analysis.

- b. Employee Exposure Records and Industrial Hygiene Surveys

- (1) Employee exposure records and associated industrial hygiene survey reports will be maintained for all industrial hygiene activities performed at KSC in accordance with 29 CFR 1910.1020.
- (2) Examples of Industrial Hygiene Surveys include facility walk through inspections, local and general ventilation surveys, illumination surveys, hazardous noise surveys, employee complaint investigations, heat stress surveys, exposure incident investigations, and emergency response reports.
- (3) It is the responsibility of each employer to maintain employee exposure and survey records for their affected employees.

CHAPTER 3. SPECIAL TOPICS

3.1 Ventilation

This section provides guidelines for the design, use, and testing of local exhaust ventilation systems and laboratory hoods used to control the generation of toxic air contaminants.

- a. Design of local exhaust ventilation systems and laboratory hoods shall effectively control employee exposures. The design specifications for the control portion (i.e. hoods, enclosures, ducts, and fans) of local exhaust ventilation systems are specified in OSHA regulations, the American Conference of Governmental Industrial Hygienists (ACGIH) Industrial Ventilation Manual, and other consensus industry standards. Other designs may be used if they are shown to effectively control the air contaminant hazard.
- b. Use
 - (1) Responsible engineering and operations organizations are responsible for ensuring the proper installation, operation, and maintenance of ventilation systems to ensure that:
 - (a) Fans are operating and rotating in the proper direction.
 - (b) Fan belts are not slipping or broken.
 - (c) Pressure drop across filters (if present) is within operating limits.
 - (d) Ducts are free from leaks.
 - (e) There is adequate make up air for the system.
 - (f) Baffles (if present) are configured properly.
 - (g) The hood and ducts are free from debris/airflow restrictions.
 - (2) Where movable hoods are used, the hoods will be placed as close as possible to the point of air contaminant generation without interfering with the work. Operators are responsible for ensuring that movable hoods are not positioned where the hood draft will pull contaminated air through the operators breathing zone.
 - (3) Ventilation systems designed to control toxic air contaminants will be tested on initial installation and at least annually to determine proper operation. The engineering/operations organization is responsible for contacting the JBOSC Industrial Hygiene (IH) Office to schedule evaluations of laboratory hoods and local exhaust ventilation systems. It is the responsibility of the operations organization to correct any deficiencies identified in the JBOSC IH Laboratory Hood or Local Exhaust Ventilation System Evaluation report.
 - (4) Systems that meet recommended design criteria will be affixed with a decal approving its use, the date of approval, and the date of the next scheduled evaluation. Systems that are not operating effectively and may put employees at risk of exposure will be tagged out of service.

- (5) The user organizations is responsible for ensuring that employees are trained in the use of ventilation systems and are aware of the ventilation systems' capabilities and limitations.

c. Testing

- (1) The JBOSC Industrial Hygiene (IH) Office will provide evaluations for all local exhaust and laboratory hood ventilation systems.
- (2) Systems will be evaluated using the recommended design criteria in the ACGIH Industrial Ventilation Manual, applicable OSHA regulations, or other applicable consensus industry standards.
- (3) The JBOSC IH Office will maintain an inventory of all registered local exhaust ventilation systems and laboratory hoods and will schedule all evaluations.

d. Baseline evaluation

- (1) The JBOSC IH Office will perform an initial baseline evaluation of local exhaust and laboratory hood ventilation systems on notification by the engineering/user organization.
- (2) The baseline evaluation will include a characterization of the type of ventilation system, identification of the air contaminants the system is designed to control, and a description of the operation or process that generates the air contaminants.
- (3) It is the responsibility of the engineering/user organization to effect repairs/redesign for systems that are not approved for use.

e. Periodic reevaluation

- (1) Local exhaust and laboratory hood ventilation systems listed in the JBOSC IH Office's inventory will be reevaluated at least annually. Ventilation systems used to control high toxicity air contaminants may be tested more frequently as determined by the JBOSC IH Office.
- (2) Local exhaust and laboratory hood ventilation system survey results will be evaluated to determine performance degradation or changes in materials, operations, or procedures.
- (3) Systems that effectively control air contaminant hazards will be affixed with a decal approving the system's use.
- (4) Systems that do not meet minimum recommended design criteria will be tagged out of service if the JBOSC IH Office determines that continued operation of the system poses a hazard to personnel.
- (5) The JBOSC IH Office will provide the user organization a written report with the results of the survey and recommendations for correcting identified deficiencies.

- (6) It is the responsibility of the user organization to effect repairs for systems that are not approved for use.

3.2 Facility Design And Modifications

This section defines industrial hygiene facility design requirements that must be considered when performing facility design and modification tasks and assigning implementation responsibilities. The incorporation of hazard controls into the initial design or modification of any facility or process is one of the most effective methods for controlling health hazards in the workplace.

- a. Requirements - Designs or modification of existing facilities or systems involving the use, storage, or processing of hazardous materials; or which have the potential to expose employees to hazardous materials or physical agents must be coordinated with the organization OIHC. Design packages must be submitted during the 30%, 60%, 90% design stages for review. Design packages should include the Document Release Authorization (DRA) (KSC Form 21-68) with all available design data and task requirements. Reference NPR 8820.2, "Design and Construction of Facilities". Examples of specific design applications that must be reviewed include the following:

- (1) Systems or processes that involve demolition, hot work, abrasive blasting or surface coating maintenance.
- (2) Design or modification of facilities used as a welding shop, painting shop, chemical processing facility, laboratory, or photo processing area.
- (3) Systems that generate excessive heat (e.g., drying ovens).
- (4) Systems that generate noise levels greater than 85 dBA.
- (5) Design or modifications that involve asbestos containing building materials (ACBM).
- (6) Design or modifications of ventilation systems used to control air contaminants.

- b. Design

When designing new facilities or planning modifications to existing facility equipment or processes, the Design Engineer must consider the occupational health hazards involved and incorporate applicable industrial hygiene hazard controls into the design.

- (1) General Design Requirements - The general health hazard control methods must be considered during facility design and modification. These include:
 - (a) Substitution of a less harmful material or process. Example: The use of non-asbestos insulating materials or paints that do not contain lead pigments.
 - (b) Isolation of an operation or process to limit personnel exposure. Example: The use of closed systems for transfer of hazardous chemicals.

- (c) Barriers to reduce or eliminate the escape of hazardous chemicals or physical agents to other areas. Example: Use of sound absorbing barriers to attenuate noise transmission.
- (d) Ventilation systems to remove or reduce the air contaminant levels. Example: Laboratory hoods, welding exhaust systems, etc.
- (2) Specific Design Requirements - Design requirements identified in the following sources shall be referenced for facility design and modification specifications:
 - (a) Illumination systems should meet the design criteria listed in the "Illuminating Engineering Society Lighting Handbook".
 - (b) Equipment or operations that generate hazardous noise must incorporate hazard controls to reduce noise levels in accordance with KNPR 1820.3, "KSC Hearing Loss Prevention Program".
 - (c) Asbestos abatement project design shall be conducted in accordance with the Class I, II, III, or IV Methods of Compliance as required by 29 CFR 1926.1101, 40 CFR 61 Subpart M, 49 CFR 171, 49 CFR 172, FAC Chapter 62-257, and Fl-Statute 469.
 - (d) Ventilation systems shall be designed in accordance with best practices described in OSHA regulations, the American Conference of Governmental Industrial Hygienists (ACGIH) Industrial Ventilation Manual, or other consensus industry standards.

3.3 KSC Asbestos Management Program

This section implements 29 CFR 1910.1001, 29 CFR 1926.1101 (Asbestos), 40 CFR part 61, 40 CFR part 763, Florida Administrative Code (F.A.C.), Rule 61E1-2, Asbestos Consultant Examination, and Florida-Statute, Chapter 469 (Fla. Stat. Ch. 469), Asbestos Abatement. The requirements of 29 CFR 1910.1001 apply to all occupational exposure to asbestos, except as provided in 29 CFR 1910.1001, paragraph (a)(2). All construction work excluded from coverage in the general industry standard for asbestos by 29 CFR 1910.1001, paragraph (a)(2), is covered by 29 CFR 1926.1101. *Special attention should be paid to the scope and application paragraph of the construction standard (the preface of the standard) as most asbestos abatement activities performed at KSC are covered within the construction standard.*

a. Material Identification

Sampling and analysis of bulk asbestos materials for the identification of Asbestos Containing Building Material (ACBM) shall be in accordance with Appendix K to 29 CFR 1926.1101.

- b. Asbestos Management Information System (AMIS)
 - (1) The AMIS database is provided to facility managers, system engineers, work-site supervisors and/or employees to obtain information for use in the performance of their various tasks. The KSC AMIS is an on-line index of identified ACBM in NASA KSC/CCAFS facilities that includes digital images of the asbestos containing building materials (ACBM) and a hazard assessment associated with areas or rooms containing friable asbestos.
 - (2) Uses and limitations –
 - (a) Material quantities and room dimensions are based on estimated values determined by the facility inspector at the time of the inspection, and the room configuration at the time of the survey.
 - (b) Sampling was performed on a non-destructive basis that may result in additional materials being found during facility renovations.
 - (c) The AMIS database does not include any roofing materials or other exterior building materials such as window caulking.
 - (d) The AMIS does not include any facilities built after 1986. While the use of ACBMs was discontinued after this date, some ACBMs like roof sealants and mastics may still be encountered.
 - (e) The AMIS does not include comprehensive survey data on trailers used for temporary housing.
 - (f) Printouts of the inspection should be used for planning purposes only. All survey information should be verified as accurate and complete at the time facility and/or system modifications actually occur. Send questions or comments to the JBOSC Industrial Hygiene (IH) Office.
 - (3) FAMS survey data is located on the KSC home page at <http://amis.ksc.nasa.gov>. To use the AMIS, select the Asbestos Survey Data option and enter a facility number to review/print specific room survey information.

c. Material Labels & Warning Signs

The JBOSC IH Office will assist the workplace supervisor/competent person in identifying the appropriate locations to post warning signs and labeling of ACBMs.

d. Ceiling Access Guidelines

There is potential for asbestos debris contamination above false ceilings. Due to the potential for personnel exposure to ACBM and possible facility contamination during entry into above ceiling areas, all unnecessary activities involving the removal of ceiling tiles should be avoided. Where work above drop ceilings requires the removal of ceiling tiles an organization should develop and use specific guidelines that minimize the likelihood for any ACBM being disturbed in

the above ceiling area and ensure compliance with OSHA asbestos regulations. As part of those guidelines the KSC AMIS should be reviewed by the organization required to perform the work for the presence of ACBM.

e. Employee Training and Licensure

- (1) Asbestos Awareness training in compliance with the OSHA Hazard Communication, Asbestos in General Industry and Asbestos in Construction should be provided to employees as required.
- (2) Employers shall provide maintenance and custodial personnel asbestos awareness training in accordance with the requirements of 29 CFR 1910.1001(j) and/or 29 CFR 1926.1101 (k).
- (3) All personnel who conduct activities that involve the identified Asbestos Disciplines, to include Inspector, Management Planner, Worker, Supervisor, Project Designer, and Project Monitor shall receive initial and annual refresher training as specified in 40 CFR part 763 Model Accreditation Program, and F.A.C., Rule 61E1-2.
- (4) All resident and non-resident employers performing asbestos abatement shall be licensed as specified in Fla.-Stat. Ch. 469. All personnel performing Asbestos consulting services to include Inspector, Management Planner, Project Designer, and Project Monitor shall work under a Licensed Florida Asbestos Consultant as specified in Fla.-Stat. Ch. 469.

f. Employee Medical Surveillance

The KSC Occupational Medicine Environmental Health Services (OMEHS) contractor will provide asbestos worker medical examinations to KSC Civil Service and resident contractor employees, to the extent provided by contract, in accordance with the requirements of 29 CFR 1910.1001(l) or 29 CFR 1926.1101 (m).

g. Operations & Maintenance Activities

Operations and maintenance activities shall be conducted in accordance with the Class I, II, III, or IV Methods of Compliance as required by 29 CFR 1926.1101, 40 CFR 61 Subpart M, and Fl.-Stat. Ch. 469.

h. Employee Notification

It is the responsibility of the operations or the responsible construction management to notify facility managers of abatement operations. Facility managers are responsible for forwarding notifications of asbestos abatement to facility tenant management points-of-contact, as required (29 CFR 1926.1101(d) 1 & 29 CFR 1910.1001 (j)).

- (1) Notification shall be provided to the manager of the facility in which the operation takes place, the JBOSC IH Office, and the JBOSC Fire Department, and the OIHC.

- (2) Notification shall include:
 - (a) Estimated Start Date & Times
 - (b) Facility Number & Name
 - (c) Work Location Or Room Number
 - (d) Project Identification Number (SON, WAP, WAD, etc.)
 - (e) Contact Name & Phone Number (Construction Management Point of Contact)
 - (f) Brief Description Of Work Or Operation To Be Conducted
- (3) Notices shall be posted at the point of operation
- (4) Placards, signs, or other notices shall be posted by the operations or responsible construction management organization at the perimeter of regulated areas. Posting will be in a location visible to other employees who work in the vicinity of the abatement operation. In addition to posting requirements identified in 29 CFR 1926.1101, the notice shall identify the type of work in progress, Project Identification Number, and provide the name and phone number of a management representative point of contact for project information and for notification in the event of an emergency.
- (5) Class I Abatement Operations

In addition to the above, Facility Managers shall provide notice of all Type I abatement operations in Shuttle or Payload processing areas in the KICS/IDS 72 hour scheduling/notification system.

 - i. Personal Protective Equipment

The use of personal protective equipment shall be as necessary to comply with the requirements of 29 CFR 1926.1101 (i) or 29 CFR 1910.1001 (h)
 - j. Waste Disposal
 - (1) All asbestos waste shall be disposed of in accordance with 40 CFR part 61 and KNPR 8500.1, KSC Environmental Requirements and handled in accordance with provisions as established in 29 CFR 1926.1101, 29 CFR 1910.1001.
 - (2) Asbestos waste shall not be disposed of in the KSC landfill or any unauthorized waste container/location within KSC area.
 - k. Emergency/Mishap Procedures
 - (1) A written emergency/mishap procedure is required for each abatement operation. The procedure will identify steps to take in the event of any emergency that takes

place as part of any hazardous asbestos abatement operation in accordance with the requirements of KNPR 8715.3 .

- (2) The Emergency Procedure Document (EPD) must:
 - (a) Ensure engineering controls and access barriers into the affected area remain in place or have been installed to ensure the safety of bystander employees.
 - (b) Ensure notification of the JBOSC IH Office of the emergency incident at 867-2400 (or 853-5211) after 1600hrs Monday-Friday, the organization OIHC or safety representative and appropriate contracting officer representative (fixed price contracts).
- (3) The operations organization is responsible for coordinating corrective actions not addressed in the EPD with the JBOSC IH Office.

I. Project Management

(1) Design

When a project involving the modification or demolition of a facility is proposed the project initiator must consider the potential hazards associated with ACBM. It is the responsibility of the project designer to determine the presence of ACBM and the need for its disturbance or removal of in determining the project scope. The project designer is responsible for ensuring the locations and quantities of identified ACBMs are included in any statement of work or other work control package provided to fixed-price or resident contractor organizations who will perform asbestos abatement. If assistance is needed in performing these aforementioned tasks contact the JBOSC IH Office.

(2) Design Review

When the presence of ACBM has been determined to be within the scope of work of a project, either through use of the KSC FAMS or through direct bulk sampling activities, the project designer is responsible for coordinating the review and approval of the design package with the JBOSC IH Office.

m. Written Compliance Plans

- (1) Each fixed-price asbestos abatement contract is required to submit a written asbestos abatement plan that describes their implementation of the requirements of 29CFR 1926.1101. It is the responsibility of the contracting organization to provide asbestos abatement plan to the JBOSC IH Office for review and concurrence prior to the start of the project.
- (2) Each resident contractor performing in-house facility operations and maintenance is required to have a written policy that describes their implementation of the requirements of 29CFR 1926.1101.

n. Project Monitoring

- (1) Each fixed-price asbestos abatement contractor and resident contractors performing asbestos abatement operations as part of in-house facility operations and maintenance activities is responsible for ensuring project monitoring in accordance with the applicable requirements of 29 CFR 1926.1101.

- (2) Pre-work Asbestos Abatement Inspection

The JBOSC IH Office is responsible for conducting all pre-abatement workplace inspections involving the establishment of regulated areas related to asbestos abatement. Asbestos abatement work may not begin until the JBOSC IH Office successfully completes a Pre-work inspection (KSC Form 32-96; Pre-work Inspection).

- (3) Final Asbestos Abatement Clearance Inspection

The JBOSC IH Office is responsible for final asbestos abatement clearance inspection prior to the opening of a regulated area for normal occupancy following an asbestos abatement activity. A regulated area may not be opened until the JBOSC IH Office successfully completes a Final Clearance inspection (KSC Form 32-95; Post Work Inspection).

3.4 Corrosion Control Operations

This section implements the requirements of 29 CFR 1910.1025, 1910.1027, 1926.62, and 1926.1127 as they apply to general industry and construction operations at KSC/CCAFS. These provisions apply to occupational exposure to lead, cadmium and other metals that may be encountered during the demolition, maintenance and repair of structures where protective coatings that contain these metals pose a hazard to personnel and the environment.

- a. All protective coatings that contain hazardous metals as must be handled in accordance with the requirements of this section.
 - (1) Sampling and analysis of protective coatings will be conducted as a part of the design phase of the demolition, maintenance, or repair project. Sampling and analysis is the responsibility of the organization planning the project or the operations and maintenance organization prior to performing O&M work.
 - (2) Where Material Safety Data Sheets for protective coatings are available and indicate the presence of hazardous metals, sampling is not required.
 - (3) Where the presence of hazardous metals is not determined prior to work, hazardous metals must be assumed to be present.
- b. Analysis results or MSDSs information will be provided to the employer organization performing the corrosion control work.
 - (1) Where work will be competed for award to a fixed price contractor, the results of the sampling and analysis will be provided with the statement of work.
 - (2) Where work will be performed by a KSC/CCAFS tenant organization, the results of the sampling and analysis will be provided to the tenant organization OIHC.

- c. Bulk samples will be collected to characterize each homogenous area of protective coating. Sample locations will be randomly selected.

Surface Area, Square feet	Number of samples
< 1000	Minimum of 3
1000 – 5000	Minimum of 5
5000 – 10000	Minimum of 7
> 10000	Minimum of 9

- d. Bulk samples will be taken in accordance with methods described in ASTM E1729-99, 'Standard Practice for Field Collection of Dried Paint Samples for Lead Determination by Atomic Spectrometry Techniques'.
- e. The method of analysis used will report the total hazardous metal content of the sample.
- f. Safety and Health Plan
- (1) A written Safety and Health Plan is required for each tenant or construction contractor that describes the implementation of measures required for compliance with applicable OSHA requirements.
- (2) It is the responsibility of the contracting organization to provide a copy of the plan to the JBOSC IH Office prior to the start of the project.
- g. Notification

It is the responsibility of the operations or the responsible construction management to notify facility managers of abatement operations. Facility managers are responsible for forwarding notifications of asbestos abatement to facility tenant management points-of-contact and the JBOSC IH Office.

- (1) Notification shall include:
- (a) Estimated Start Date & Times
- (b) Facility Number & Name
- (c) Work Location
- (d) Project Identification Number (SON, WAP, WAD, etc.)
- (e) Contact Name & Phone Number (Construction Management Point of Contact)
- (f) Brief Description Of Work Or Operation To Be Conducted
- (2) In addition to the above, Facility Managers shall provide notice of all Type I abatement operations in Shuttle or Payload processing areas in the KICS/IDS 72 hour scheduling/notification system.

- (3) Where a regulated control area is established, placards, signs, or other notices shall be posted by the operations or responsible construction management organization at the perimeter of regulated areas. Posting will be in a location visible to other employees who work in the vicinity of the operation. In addition to the applicable posting requirements of 29 CFR 1910.1025, 1910.1027, 1926.62, or 1926.1127, the notice shall identify the type of work in progress, Project Identification Number, and provide the name and phone number of a management representative point of contact for project information and for notification in the event of an emergency.

3.5 Confined Space Program

This section establishes the requirements and procedures for a program to manage the entry into and work within confined spaces and controlled access areas at the Kennedy Space Center.

a. General

- (1) Confined spaces are spaces that are large enough and so configured that an employee can bodily enter and perform assigned work; and has limited or restricted means for exit, and is not designed for continuous employee occupancy.
- (2) Work spaces that do not meet the definition of a confined space, but contain hazards that must be controlled prior to entry will be classified as a controlled access area.
- (3) All operations and activities (including construction) that require entry into a confined space will require the implementation of this section and the applicable requirements of 29 CFR 1910.146, 1910.268, 1910.269, 1926, or 1915.
- (4) All confined spaces, regardless of type or designation will require an entry authorization document that identifies hazardous conditions and entry requirements.

b. Atmospheric Monitoring

Atmospheric monitoring is a requirement as a part of the pre-entry assessment where air contaminants may be present. Continuous monitoring is required where the authorized entrants will be working when the employer allows entry without pre-entry determination of acceptable entry conditions for spaces and where isolation is infeasible because the space is large or part of a continuous system such as a sewer system.

c. Confined Space Entry Program Plan

- (1) Each contractor who's scope of work requires entry into and work in confined spaces shall have a Confined Space Entry Program Plan that implements the requirements of (29 CFR 1910.146, 1910.268, and 1910.269), this KNPR, and KNPR 8715.3, *KSC Safety Practices Procedural Requirements*.

- (2) Where the contractor will act as a controlling employer with operational control over the permit space during multiple employer entry, the plan shall incorporate procedures to coordinate entry operations (for example, hazardous operations, required PPE, employee training, rescue, emergency services, and all other aspects of the entry requiring coordination) with each entrant's employer.
- d. Confined Space Hazard Evaluation
- (1) The confined space hazard evaluation process and program implementation is designed to provide interaction of relevant disciplines to develop and facilitate a thorough hazard evaluation of the confined spaces.
 - (2) It is the responsibility of the organization who controls access to the confined space to initiate the Confined Space Hazard Evaluation described in this section.
 - (3) The user organization will perform an assessment of assigned work areas to identify potential confined spaces and complete a Confined Space Hazard Evaluation form (KSC Form 28-750 NS) for each space and submit it to the JBOSC Industrial Hygiene (IH) Office.
 - (4) The JBOSC IH Office is responsible for adding the submittal to the Confined Space Inventory.
 - (5) The user organization is responsible for developing and coordinating the Confined Space Hazard Evaluation with the organization safety and health office, JBOSC IH Office, and JBOSC Fire and Rescue. Other affected shop management and personnel, organization operations and engineering may participate as required to identify:
 - (a) hazards within or near the space,
 - (b) hazards associated with the operations in the space,
 - (c) hazard controls,
 - (d) entry requirements and procedures and
 - (e) emergency rescue requirements.
 - (6) JBOSC IH Office will issue a Confined Space Hazard Evaluation Summary that identifies:
 - (a) The representatives who participated in the evaluation;
 - (b) Provide a description of the confined space;
 - (c) The operation(s) requiring personnel entry into the space;
 - (d) Any atmospheric or physical hazards and the monitoring requirements and hazard controls;

- (e) The health and safety hazards in the space associated with the operations performed in the space;
- (f) Any hazardous commodities stored in the space;
- (g) Requirements for atmospheric testing for entry including required periodic or continuous monitoring;
- (h) Requirements for employee training and certification, including medical certification, respirator use, etc.;
- (i) Requirements for personal protective equipment (PPE), including respiratory protection, to be used while working in the space;
- (j) Special requirements such as method of entry, standby personnel, communications, access control, or emergency response.
- (k) Applicable alternate entry procedures;
- (l) Any recommendations necessary to ensure a safe authorized entry (i.e. additional hazard controls, special equipment).
- (7) The JBOSC IH Office is responsible for maintaining a record of all confined space hazard assessment reports and maintaining the Confined Space Inventory.
- (8) The JBOSC Fire Services is responsible for developing and maintaining the confined space rescue plans and providing rescue and emergency services in accordance with 29 CFR 1910.146(k) based on the confined space emergency rescue requirements identified in the Confined Space Hazard Evaluation.
- (9) The user organization is responsible for internal implementation of the entry requirements identified in the summary report and communicating them to their subcontractors.
- (10) A change in the hazards associated with the confined space or operations requires reevaluation of entry requirements. Requests for reclassification or additional hazard evaluation are submitted by the user safety and health organization to JBOSC IH Office following the same procedures as the initial Confined Space Hazard Evaluation. Submittals include:
 - (a) specific reference to the previous Confined Space Hazard Evaluation Summary document,
 - (b) a review of permits and activities in the space since the previous evaluation, and
 - (c) specific reasons for and data to support a reclassification, and/or
 - (d) an outline of proposed operation(s) and associated hazards (KSC Form 28-750).

e. Confined Space Permit System

The Confined Space Entry Permit/Authorization (KSC Form 16-287) is a written authorization that identifies and documents all conditions that must be met to ensure safe entry into confined spaces. This permit system is established to meet the requirement of 29 CFR 1910.146(c) for a written permit space program. Specific provisions for each permit will be based on the results of the Confined Space Hazard Evaluation Summary or hazard assessment performed at the time of entry that includes all elements of the Confined Space Hazard Evaluation.

- (1) Entry into the following confined spaces will require the completion, posting and cancellation of Form 16-287:
 - (a) Permit Required Confined Space (PRCS)
 - (b) Alternate Procedures Permit Space (APPS)
 - (c) Telecommunications Confined Space (TCCS)
 - (d) Electrical Power Confined Space (EPCS)
 - (e) Permit Space reclassification
- (2) A written work-authorizing document that specifies entry requirements of the confined space hazard evaluation summary may be used in lieu of the KSC Form 16-287.
- (3) Where employees of more than one employer are required to work simultaneously as authorized entrants in a permit-required confined space entry, entry will be under an integrated work-authorizing document approved by each employer's safety representative in accordance with the requirements for Hazardous Technical Operating Procedures described in KNPR 8715.3.
- (4) Entry into designated non-permit confined spaces will require written authorization which shall identify the date, the location of the space, operations in compliance with the Confined Space Hazard Evaluation Summary, and the signature of the person authorizing entry. This authorization, documented on Form 16-287 or equivalent work-authorizing document, is to be available to an entrant and a copy retained by the user organization.
- (5) The user organization is responsible for retaining the canceled permits for at least one year, reviewing the permits annually and revising the Confined Space Program as necessary to ensure that employees participating in confined space entries are protected from confined space hazards.
- (6) Entry into a confined space that has not had a Confined Space Hazard Evaluation by the user organization is restricted to the following conditions:
 - (a) A KSC Form 16-287 will be used to control work in the space pending issuance of a Confined Space Hazard Evaluation Summary.

- (b) The user organization is responsible for coordinating completion of the KSC Form 16-287 with the organization safety and health office.
- f. Prior to entry into a confined space the user organization ensures:
 - (1) the hazard controls and procedures of the entry plan documented in the Confined Space Hazard Evaluation Summary are implemented;
 - (2) the confined space is tested for the atmospheric hazards identified in the space; (Atmospheric testing is performed by personnel trained and certified by the user organization to perform the testing (Section g below) or JBOSC IH Office.
 - (3) entry supervisors, entrants, and entry attendants have required training and certification;
 - (4) entry supervisor, entrants and attendants understand the hazards and requirements for the entry;
 - (5) the permit is signed by the entry supervisor to authorize entry;
 - (6) the permit is made available, at the time of the entry, to all authorized entrants, by posting it at the entry portal or by any other equally effective means, so that the entrants can confirm that pre-entry preparations have been completed;
 - (7) coordination with Fire Rescue when required;
 - (8) the entry must be terminated when the task covered by the entry permit is complete or if a condition arises which is not allowed under the permit.

g. Confined Space Training

The user organization provides training to all affected employees so that these employees can acquire the understanding, knowledge, and the skills necessary for the safe performance of their job duties to ensure an authorized safe entry.

- (1) General Confined Space Entry Training (QG-103 or equivalent) is the minimum training required for all entrants, attendants, and entry supervisors entering confined spaces, with the exception of designated non-permit confined spaces and controlled access areas.
- (2) Training content must include elements identified in the applicable standards (1910.146 and/or 1910.268 or 1910.269).
- (3) Additional training (e.g. fall protection, respirator user) to address specific hazards associated with confined space entry operations may be required by the user organization.
- (4) Required training for entrants into non-permit confined spaces and controlled access areas will be identified on the Confined Space Hazard Evaluation Summary.

- (5) The user organization is responsible for ensuring that personnel conducting atmospheric testing for entry into confined space receive training in the operation and care of testing equipment, interpretation of data, standards to be met, and procedures to follow when anomalies are determined.
- (6) The JBOSC Occupational Medicine will provide medical certification to the extent provided by contract when required for confined space certification.
- (7) The PM50 training records system will be used to document required training and certification.
- (8) The entry supervisor is responsible for ensuring that the confined space entrants meet the necessary training requirements for work in the space prior to authorizing the confined space entry.

3.6 Heat Illness Prevention Program

This section describes general policy for conducting heat stress hazard assessments and prevention of heat illness at the Kennedy Space Center and Cape Canaveral Air Force Station. These provisions apply to operations involving high air temperatures, radiant heat sources, high humidity, direct physical contact with hot objects, strenuous physical activities, or activities requiring use of semi-permeable or impermeable protective clothing which are likely to cause heat stress among exposed workers.

a. Heat Exposure Guidelines

Guidelines for performing heat illness hazard assessments will be based on the ACGIH publication, Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices.

b. Heat Illness Hazard Assessments

Heat illness hazard assessments will be performed by JBOSC Industrial Hygiene (IH) Office and will include a background description of the operations or processes identified in the assessment, work-site interviews of employees performing the work, a work load assessment, and environmental monitoring measurements.

- (1) **Background** - The operation description will include the name, procedure number, or other identification; a brief description of the operation or procedure; the location(s) where the work is performed; their duration and frequency; and a description of any work practices, engineering control measures, or PPE provided to provide for rest or protection from heat.
- (2) **Work-site Interviews**. – Employee interviews should be conducted to determine what heat stress problems have been experienced, any work practices or other measures taken to minimize heat stress; and any training or other information on heat stress provided to employees.

- (3) Work Load Assessment – A metabolic work load assessment will be used to determine the work load category of each job being assessed. Guidelines for performing workload assessments will be based on the ACGIH publication, Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices.
- (4) The heat illness hazard assessment will be based on the Screening Criteria for Heat Stress Exposures for acclimated and unacclimated employees published in the ACGIH Threshold Limit Values.

c. Environmental Monitoring Measurements.

- (1) The Wet Bulb Globe Temperature (WBGT) should be calculated using the appropriate formula in ACGIH publication, Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices or measured using direct-reading portable heat stress meters or monitors.
- (2) The JBOSC IH Office is responsible for measurement and posting of WBGT measurements and notification of affected operations organizations during the warm weather months (normally May through September) of each year.

d. Reports

Upon the completion of health hazard evaluations, a report of the findings shall be issued. The report format will be in accordance with that described in paragraph 2.3 (I) of this KNPR.

e. Recommended Control Measures.

When the heat illness hazard assessment identifies heat exposures in excess of those recommended by the ACGIH, acclimatization and fluid management, engineering control measures, administrative controls and work practices, and/or use of PPE will be used to reduce risk of heat illness.

f. Hazardous Operating Procedures

Written hazardous operating procedures are required for all work for more than one hour duration requiring the use of semi-permeable or impermeable protective garments at ambient temperatures of more than 80 degrees Fahrenheit and for any other operation where required by a heat illness hazard assessment. Operating procedures will be in accordance with the KNPR 8715.3 "KSC Safety Practices Procedural Requirements" requirements for hazardous operating procedures.

g. Acclimatization and Fluid Management-

- (1) Acclimatization is acquired through performance at a specified workload under ambient environmental conditions over several days. Contact JBOSC IH for recommended acclimatization schedules.

- (2) Fluid Replacement - Ample supplies of cool water or other appropriate liquid should be readily available at the work-site. Employees should be provided frequent breaks to drink fluids.

h. Engineering Controls.

Feasible engineering control measures should be considered as a primary means for controlling heat illness hazards. The heat illness hazard assessment will identify operations where implementation of engineering control measures (in conjunction with other control measures) is appropriate. Examples of effective engineering controls include:

- (1) Use of power assists and tools that reduce the physical demands placed on a worker.
- (2) General ventilation (generally cooler air that is brought in from the outside).
- (3) Air-conditioning where feasible.
- (4) Cooling fans. Because this method does not actually cool the air, any increases in air speed must impact the worker directly to be effective.

Note: Use of cooling fans is not appropriate in some conditions. 1) If the dry bulb temperature is higher than 35°C (95°F), the hot air passing over the skin can actually make the worker hotter. 2) When the temperature exceeds 35°C and the relative humidity is 100%, air movement will make the worker hotter. 3) Increases in air speed have no effect on the body temperature of workers wearing vapor-barrier clothing.

- (5) Shaded work areas.
- (6) Heat shields and insulation of hot surfaces in the workplace.

i. Administrative Controls and Work Practices.

Examples of effective administrative and work practice controls include:

- (1) Scheduling hot jobs for the cooler part of the day;
- (2) Scheduling routine maintenance and repair work in hot areas for the cooler seasons of the year;
- (3) Reducing the physical demands of work, e.g., excessive lifting or digging with heavy objects;
- (4) Providing cool rest areas;
- (5) Using intermittent rest periods with water breaks;
- (6) Using relief workers;
- (7) Using worker pacing; and

- (8) Assigning extra workers and limiting worker occupancy, or the number of workers present, especially in confined or enclosed spaces.

- j. Personal Protective Equipment (PPE)

Certain types of personal protective equipment may be effective in preventing heat related illnesses when used in combination with other control measures. These include:

- (1) Commercially available cooling vests.
- (2) Reflective Clothing.
- (3) Water-cooled garments.
- (4) Circulating air personal cooling systems, such as vortex coolers.

- k. Worker Monitoring Programs.

A monitoring program may be required under extraordinary conditions such as wearing semi-permeable or impermeable clothing or working at extreme metabolic loads. Monitoring may be done by checking the heart rate, recovery heart rate, body temperature, or extent of body water loss. JBOSC IH Office will determine appropriate worker monitoring requirements based on the heat illness hazard assessment.

- l. Training

- (1) Employer should ensure that heat stress awareness is provided for employees who:
 - (a) Perform work outdoors or in un-insulated shops and equipment sheds;
 - (b) Work around radiant heat sources;
 - (c) Wear semi-permeable or impermeable protective clothing when required to perform assigned work.

The JBOSC IH Office can provide assistance with this type of training, when needed.

- (2) Determination of requirement for heat stress awareness training will be made as a part of the Heat Illness Hazard Assessment report.

3.7 MSD Management Program

This Section establishes the Musculoskeletal Disorder (MSD) management program at the Kennedy Space Center. The support services described in this section are available to all Civil Service organizations and to NASA contractor organizations as defined in their respective contracts.

Musculoskeletal Disorders (MSDs) constitute one of the most significant preventable causes of employee lost time injuries and illnesses. These injuries and illnesses are caused by irritation and inflammation to the muscles, tendons, and peripheral nerves and are associated with performing common everyday tasks, either in the workplace or at home.

a. Signs and Symptoms of Common MSDs

Exposure to MSD risk factors can cause irritation and inflammation of muscles, joints, and tendons. Redness, swelling, and restricted movement are common signs of MSDs. Symptoms of MSDs can include persistent numbness, tingling sensations, pain, aches, or burning sensations. There are other causes of these signs and symptoms that may be unrelated to MSD risk factors. These may be of serious nature and should be further investigated by a physician.

b. Table of Common MSDs

Carpal Tunnel Syndrome	A disorder associated with chronic compression of the median nerve where it passes through the carpal tunnel of the wrist.
Cubital Tunnel Syndrome	A disorder associated with irritation of the ulnar nerve where it passes over the elbow.
Tendonitis	A general term given to irritation and inflammation of a tendon.
Epicondylitis	A term used to describe forms of tendonitis associated with the elbow and forearm.
Stenosing Tenosynovitis	A disorder that occurs when the tendon surface does not move smoothly over the tendon sheath due to inflammation that constricts the movement of the tendon.
Synovitis	An inflammation of the bursae (fluid filled sacs that act to cushion movement) that are in the shoulder, elbow and knee.
Ganglion Cyst	A swelling caused by accumulation of fluid in a tendon sheath.
Thoracic Outlet Syndrome	A disorder caused by compression of the nerves and blood vessels between the neck and shoulder.
Raynaud's Syndrome	A disorder caused by the constriction of blood flow to the hands and fingers. It is most commonly associated with the use of vibrating tools.
Vibration Trauma	A disorder of the lower back that has been associated with whole-body vibration.

c. MSD Risk Factors

- (1) **Force** - Tasks or motions that require the application of higher force place higher mechanical loads on muscles, tendons, ligaments, and joints and may cause muscles to fatigue more quickly.
- (2) **Repetition** - When motions are repeated frequently (e.g., every few seconds) for prolonged periods such as several hours or an entire work shift, fatigue and strain of the muscle and tendons can occur because there may be inadequate time for recovery. Repetition often involves the use of only a few muscles and body parts, which can become extremely fatigued even though the rest of the body is unaffected.

- (3) Awkward or static postures - Awkward postures often are significant contributors to MSDs because they increase the exertion and the muscle force that is required to accomplish the task, and compress soft tissues like nerves, tendons, and blood vessels. Prolonged sitting and standing (a form of static posture) are also risk factors for MSDs.
- (4) Contact stress - Contact stress commonly affects the soft tissue on the fingers, palms, wrists, forearms, thighs, shins and feet. This contact may create pressure over a small area of the body (e.g., wrist, forearm) that can inhibit blood flow, tendon and muscle movement and nerve function.
- (5) Vibration – Hand-arm and whole body vibration can contribute to MSDs. Vibrating hand tools transmit vibrations to the operator and, depending on the level of the vibration and duration of exposure, may contribute to the occurrence of circulatory disorders. Whole-body vibration has been associated with back injury.
- (6) Cold – Cold temperature is also a risk factor because it could require workers to increase the force necessary to perform their jobs (such as having to grip a tool more tightly).
- (7) Pre-existing injury or illness - Certain injuries or illnesses that affect the musculoskeletal system, circulation, etc. may place affected employees at greater risk of a work-related MSD or aggravation of the existing condition.

d. MSD Hazard Assessment and Corrective Actions

Work area supervisors are responsible for completing a Job Hazard Analysis (JHA) for the following:

- (1) each office job where employees use a computer workstation for more than 4 hours/day;
 - (2) non-office tasks (Processing Areas, Shops, and Labs) with possible ergonomic risk factors;
 - (3) jobs where employees complain of work-related MSD signs or symptoms or;
 - (4) where work-related MSD injuries have occurred.
- e. Examples of ergonomic risk factors and recommendations to be considered when completing JHAs for ergonomic hazards are listed in Table 1 and Table 2. The employer can also use the information provided in JBOSC IH Office's MSD Hazard Assessment (ergonomic evaluation) in completing a JHA. NASA employees should use the Job Hazard Analysis Form KDP-KSC-F-3242.
- f. JHAs will be reviewed annually with affected employees.
- g. In the event that an employee reports persistent signs or symptoms of a possible MSD, or aggravation of a pre-existing medical condition, the employee's supervisor is responsible for ensuring that the employee report to a KSC clinic for

medical evaluation. On evaluation, the physician will determine the necessity for the JBOSC Industrial Hygiene (IH) Office to conduct a MSD Hazard Assessment.

- h. The MSD Hazard Assessment will identify ergonomic risk factors and provide recommendations on minimizing or abating those risk factors. A written report will be provided to the employee's employer, JBOSC Medical, and the NASA Industrial Hygiene Officer.
- i. The work area supervisor is responsible for abatement of MSD hazards identified in the MSD hazard assessment.
- j. Employees will be given the opportunity to participate in the identification and implementation of workstation changes and other corrective actions required to eliminate or control identified MSD hazards.
- k. The JBOSC IH Office will contact evaluated employees approximately 3 months following their MSD Hazard Assessment (ergonomic evaluation) to determine if symptoms have subsided and if recommendations provided in the written report were implemented.
- l. The JBOSC IH Office will provide consultation services on request from Health and Safety Offices to assist in identifying appropriate workstation adjustments, accessories, ergonomic furniture, tools or work practices required to abate or minimize identified hazards.
- m. Office Ergonomics training (#QG182KSC or equivalent) is required for NASA employees who are Office Workers. This video course is provided on the NASA Information and Training Station (Channel 60). Equivalent training is also acceptable.

General Ergonomic Awareness Training (QG 122JBO or equivalent) is required for NASA employees and their supervisors employed in industrial areas, shops, and labs. Where a MSD hazard assessment or Job Safety Analysis requires task-specific instruction on the use of required engineering controls measures, protective equipment, or administrative procedures the supervisor is responsible for ensuring the instruction is provided as a part of the skills training for the job or alternately incorporated into the written operating procedure for the job.

- n. Reporting of MSDs and Medical Assessment
 - (1) Employees are required to report MSD signs and symptoms to their supervisors.
 - (2) Employees who report persistent MSD signs or symptoms should report to the JBOSC Medical for medical assessment. Persistent signs or symptoms, which last for days or weeks, may worsen over time if not treated.
 - (3) The examining physician will provide a written opinion of the initial assessment and will make employee referrals to a local medical provider, the KSC RehabWorks program, and the JBOSC IH Office as required.

- (4) The physician's written opinion will be on the KSC Form 6-2 'Initial Record of Injury' and/or the 16-261 'Medical Disposition'. A copy will be provided to the employee, the safety office, and the employee's supervisor. The employee's supervisor/employer should forward the physician's written opinion to the employer's MSD case manager. The written opinion should include an initial diagnosis and any applicable work restrictions for the employee.
- o. MSD Case Management
 - (1) Each employer is required to provide for MSD case management, to include review of completed 6-2s or 16-261s, JSAs or hazard assessments and, in coordination with the treating physician, determine any necessary work restrictions and/or other accommodations required facilitating their recovery.
 - (2) The organization responsible for MSD Case Management will develop a case file for each patient to track his or her medical progress.
 - (a) Case files may be closed when it is determined that the employee has recovered from the MSD or when a maximum medical improvement is reached.
 - (b) If the employee is not recovering as expected the employee should be re-examined at JBOSC Medical. The examining physician will then determine if another review of the employee's work-site should be initiated by contacting the JBOSC IH Office.
 - (c) The employee's line management organization is responsible for correction of MSD hazards affecting the employee's recovery.

Table 1 – Examples of Office Work Ergonomic Risk Factors and Recommendations

<u>Risk Factor</u>		<u>Recommendations</u>
<u>Repetitive Motion</u>		
<p>Operating a keyboard and/or mouse for more than 4 hours a day. Repetitively using a stapler, hole puncher or other document preparation device for more than 2 hours a day. Repetitively performing any task for more than 2 hours a day.</p>		<p>Take short (5min) breaks away from repetitive tasks. Use automated equipment, such as an electric stapler. Alternate keyboard work with other tasks. Try using keyboard commands instead of mousing. Try switching hands to operate a mouse.</p>
<u>Awkward or Static Posture</u>		
Back	<p>Back is awkwardly bent or twisted. Lower and/or upper back not fully supported by workstation chair. Chair is not comfortable.</p>	<p>Position computer monitor and keyboard directly in front of operator. Adjust chair in order to sit in an upright or slightly reclining position with lower/upper back supported by chair. Use a chair that is comfortable, and supports lower and upper back. Use a small pillow, rolled towel, or lumbar device, if necessary for added support.</p>
Arms	<p>Elbows are positioned below the level of the keyboard/mouse. Upper arms are held away from the body. Upper arms and forearms are held at an acute (<90 degree) angle. Over-reaching with an arm to operate the mouse. Over-reaching with an arm or twisting the body to answer the phone or reach for an object.</p>	<p>Adjust height of chair or adjust keyboard height so that elbows are at same level or slightly higher than keyboard. Adjust chair/keyboard so work can be performed with arms close to the body and upper arms and forearms are held at an open (90 – 110 degree) angle. Move frequently used items within arm's reach. Keep mouse adjacent to keyboard. If necessary:</p> <ul style="list-style-type: none"> • use a retractable keyboard tray if desk surface does not have adequate room. • use an alternative mouse such as a trackball or roller bar • use a mouse bridge over keypad portion of keyboard
Wrists	<p>Wrists bent backwards, forward, inward or outward and not in a straight position while operating a computer keyboard, mouse or adding machine.</p>	<p>Adjust keyboard/chair height so that the keyboard is in the same plane as the forearms. Adjust keyboard slope to a flat or negative tilt position to achieve neutral wrist posture. Use an alternative style keyboard or mouse, if necessary to keep wrists from being deviated (positioned inward or outward).</p>

	<u>Risk Factor</u>	<u>Recommendations</u>
Legs Knees Feet	Inadequate legroom. Feet are not flat on the floor or on a footrest.	Remove objects or desk drawer from under the desk to allow for sufficient legroom. If a computer is used in the corner of an L shape workstation, try using a corner piece to bring the keyboard tray closer to the body. If necessary, obtain another desk or use a retractable keyboard tray. After adjusting chair height, use a footrest if necessary.
Neck	Employee must twist neck to view computer monitor while keyboarding. Employee must bend neck to view monitor. Employee must bend/twist neck to view documents being copied. Employee braces phone between shoulders and neck while working on the computer for more than 2 hours a day.	Position computer monitor and keyboard directly in front of operator. Raise or lower the computer monitor so that top of monitor is approximately at eye level. For employees with bifocals lower monitor to point where it can be viewed with neutral neck posture. Use an adjustable document holder to hold documents at eye-level and next to the computer monitor. Use a speakerphone or headset.
Static Posture	Operator sits at computer workstation without interruption.	Alternate keyboard work with other tasks to allow moving around. Change positions frequently and if able perform stretching exercises. Take short breaks (5min/hr).
Contact Stress		
	Wrists, palms, legs, forearms, knees or elbows rest on sharp or hard surfaces.	Avoid resting wrists, forearms on edge of desk. Misuse of wrist rests may restrict circulation. When used, rest the palm of the hand and not the soft part of the wrist on the padding. Do not use hard/firm wrist rests. "Float" wrists above keyboard while typing. Use a footrest to raise thighs and keep feet stable. Use a chair that has a seat pan (width and depth) that accommodates the user. Use a chair that has cushioned and rounded ("waterfall") front. If needed, rearrange workstation to avoid contact stress to legs.
Excessive force		
	Excessive force required to grip or hold writing instruments, mouse or other office tools (staplers, hole punches, etc.) for more than 2 hours a day.	Take short breaks. Use soft padded gripping devices with writing instruments. Use a mouse that adequately fits hand or use alternate device (trackball, rollerbar, etc.) Ensure that ball on the bottom of the mouse is clean. Ensure that mousing area is large enough. Use ergonomic office tools to minimize forceful exertions.

Other risk factors		
Eye-Strain	VDT is not viewed between 18" to 30" away from the operator. The VDT has excessive glare. Low illumination levels are present where the operator views documents.	Place VDT just past arm's length (18" to 30"). If necessary, use a retractable keyboard tray to increase VDT viewing distance. Minimize VDT glare by using a visor around the VDT, a glare screen, or by adjusting VDT away from light sources. Adjust the color, brightness and contrast on VDT to minimize eye-strain. Use supplemental lighting in document viewing areas.
Control over work pace	No control over work pace. Machine paced, piece rate, constant monitoring, or daily deadlines.	Use administrative controls and job rotation to alternate personnel to perform various tasks, when able. Take frequent micro-breaks.

Table 2 – Examples of Non-Office (Industrial) Ergonomic Risk Factors and Recommendations

<u>Risk Factor</u>		<u>Recommendations</u>
<u>Repetitive Motion</u>		
<p>Repeating the same motions every few seconds or repeating a cycle of motions more than twice per minute for more than 2 consecutive hours. Using an input device, such as a keyboard or mouse, in a steady manner for 4 hours total in a workday.</p>		<p>Take frequent micro-breaks away from repetitive tasks. Use a timer, if necessary, to help as a reminder. Use tools with multiple finger triggers. Use automated equipment, when able. See recommendations for keyboard and mouse use in Table 1.</p>
<u>Awkward or Static Posture</u>		
Back	<p>Forward and backward bending and/or twisting of torso (back not straight and upright) for more than 2 hours per day. Prolonged sitting without lower and/or upper back not fully supported by workstation chair. Chair is not comfortable.</p>	<p>Perform task in a location, which minimizes bending and twisting. If necessary, elevate item on workbench or lower workbench. Adjust chair in order to sit in an upright position. Use a chair that is comfortable, and supports lower and upper back. Use a small pillow, rolled towel, or lumbar device, if necessary for added support. If applicable, consider using a sit/stand chair. Consider designing tools that will enable work to be performed with a neutral back posture.</p>
Arms	<p>Forearms are not parallel to floor. Forearms are not supported. Upper arms are not vertical and close to the body. Elbows are not at a 90° angle. Over-reaching with an arm to reach for an object. Repeatedly raising or working with hands above the head or elbows above the shoulders for more than 2 hours total per day.</p>	<p>Adjust height of workstation table or have worker stand on a platform in order for forearms to remain parallel to floor, upper arms close to body, shoulders relaxed and elbows at a 90° angle. Use chair armrests, forearm support devices or a forearm support board for forearm support. Move frequently utilized items within arm's reach and at waist height. Consider designing tools that will enable work to be performed with a neutral arm posture.</p>
Wrists	<p>Wrists bent backwards, forward, inward or outward and not in a straight position while operating tools.</p>	<p>Try various styles of tools or consider designing tools to keep wrists from being bent and deviated (positioned inward or outward).</p>

	<u>Risk Factor</u>	<u>Recommendations</u>
Legs Knees Feet	When sitting thighs are not parallel to floor. When sitting knees are not at a 90°-110° angle. When sitting feet are not flat on the floor or on a footrest. Inadequate legroom. Kneeling or squatting for more than 2 hours total per day. Bending of ankle.	Adjust chair height to keep thighs parallel to floor. Use a footrest to raise thighs and keep feet flat on the floor. Remove objects or drawer from under the workbench to allow for sufficient legroom. If necessary, perform task at another workbench. If able, move task to another location that will eliminate the need to kneel, squat or bend ankle. Take frequent micro-breaks from extensive kneeling, squatting or bending ankle. Use cushioned insoles in shoes.
Neck	Neck is bent or twisted while performing task for more than 2 hours a day.	Perform task in a location, which allows the worker's neck to remain straight and not bent. Consider designing tools that will enable work to be performed with a neutral neck posture.
Static Posture	Worker stands or sits while performing a task for more than 2 hours a day.	Change positions frequently and if able perform stretching exercises. Alternate tasks to allow for sitting and standing throughout work day. Use anti-fatigue mats. Use a sit/stand chair.
Contact Stress		
	Wrists, palms, legs, forearms, knees or elbows rest on sharp or hard surfaces. Using the hand or knee as a hammer more than 10 times per hour or more than 2 hours total per day.	Use a soft edge on workstation edges. Use a chair with soft padded armrests. Use a chair that has a seat pan (width and depth) that accommodates the user. Use a chair that has cushioned and rounded ("waterfall") front. If needed, rearrange workstation to avoid contact stress to legs. Use tools that have padded handles or add grip tape. Avoid tools with sharp edges. Avoid tools with handles that are too short; instead use long-handled tools. Use padded gloves. Use knee or elbow pads or padded mats. Try using tools that will eliminate using the hand or knee as a hammer.
Forceful exertions		
	Excessively gripping or pinching tools for more than 2 hours a day. Pushing/pulling more than 20 pounds initial force for more than 2 hours total per day. Pinching an unsupported object weighing 2 or more	Take frequent micro-breaks away from excessively gripping or pinching. Use tools with padded handles. Use tools with proper grip span (between 50-67 mm). Use tools with adequate diameter handles. If possible, choose tools that require a power grip verses a pinch grip.

	pounds per hand for more than 2 hours total per day. Gripping force of more than 10 pounds for more than 2 hours total per day.	Avoid tools that are too heavy or bulky. Use padded gloves. Use automated tools, when able, to minimize forceful exertions. If possible, use counter-balancing harness for heavier tools.
	Lifting more than 75 pounds even once. Lifting more than 55 pounds more than 10 times a day. Lifting more than 25 pounds below knees, above shoulders, or at arms' length more than 25 times a day. Lifting with a twisted torso. Lifting one-handed. Lifting un-stable loads. Lifting above shoulder. Lifting below the knuckle. Carrying objects for an extended distance. Lifting while seated or kneeling.	Use two people to lift items. Use a lifting device (hoists, robotics, forklifts, dollies, etc.). Use a cart to carry object extended distances. Put less amount of weight in containers. Make loads more compact and easier to handle. Put items in containers with handles. Try to lift items from waist height and close to body. Carry items at waist height and close to body. Use administrative controls and job rotation to alternate personnel to perform tasks that do not involve manual handling. Take adequate breaks away from lifting tasks.
Vibration		
	Performing tasks with localized vibration or whole-body vibration for more than 2 hours a day. Using vibrating tools with high vibration levels, such as chainsaws or percussive tools, for more than 2 hours total per day. Using tools with moderate vibration levels, such as grinders or sanders, for more than 2 hours total per day.	Perform routine maintenance on tools to reduce vibration. Use vibration dampening material, where feasible. Use anti-vibration gloves. Consider using tools that emit less vibration. Look for tools with variable torque control. Substitute with manual tools when possible. Use administrative controls to rotate workers to other tasks, which do not involve vibration.
Cold temperatures		
	Worker exposed to air temperature of less than 60°F for sedentary work, 40°F for light work, 20°F for moderate/heavy work; cold exhaust blowing on hands.	When able, increase ambient temperature. Wear body clothing and protective gear, such as gloves to reduce exposure.
Other Risk factors		
Eye-Strain	Low illumination levels are present where the worker performs task.	Use supplemental lighting in document viewing areas.
Control over work pace	No control over work pace. Machine paced, piece rate, constant monitoring, or daily deadlines.	Use administrative controls and job rotation to alternate personnel to perform various tasks, when able. Take frequent micro-breaks.