



Langley Research Center

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LANGLEY RESEARCH CENTER ERGONOMICS PROGRAM

National Aeronautics and Space Administration

Responsible Office: Office of Safety, Security, Environment, and Mission Assurance

PREFACE

P.1 PURPOSE

This Langley Research Center (LaRC) Procedural Requirements (LPR) sets forth the responsibilities and procedures for the LaRC Ergonomics Program and is part of the Center's Safety Manual. The Office of Safety, Security, Environment and Mission Assurance (OSSEMA) is the LaRC contact for the Ergonomics Program.

The Ergonomics Program is designed to provide the framework for implementing a successful program for preventing and managing musculoskeletal disorders (MSDs).

P.2 APPLICABILITY

These procedural requirements are applicable to all LaRC facilities and employees. The requirements of these procedural requirements are to be incorporated into any contract under which contractor employees will be assigned to on-site LaRC activities that may lead to the development of MSDs.

It is the responsibility of Contractors to provide and implement their own ergonomics program. As a minimum, these shall be in accordance with LaRC programs as described herein.

P.3 AUTHORITY

- a. NPD 1820.1, "NASA Environmental Health Program."

P.4 REFERENCES

- a. NASA Procedural Requirements (NPR) 1800.1, "NASA Occupational Health Program Procedures."
- b. NPR 8715.3, "NASA Safety Manual."
- c. NPR 8715.1, "NASA Safety and Health Handbook, Occupational Safety and Health Programs."
- d. Langley Policy Directive (LAPD) 1700.2, "Safety Assignments."

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- e. LMS-CP-4760, "Reporting Injuries, Illnesses, Compensation Claims and Unsafe Working Conditions."
- f. "Ergonomics" proposed OSHA Standard, 29 Code of Federal Regulations (CFR) 1910.900.
- g. "Elements of Ergonomics Programs," National Institutes of Safety and Health
- h. Lawrence Livermore National Laboratory Environment, Safety and Health Manual, Volume II, Document 19.1 "*Ergonomics*"
- i. Langley Form 19, "Office Ergonomics Evaluation Checklist."

P.5 CANCELLATION

None

original signed on file

Roy D. Bridges, Jr.
Director

DISTRIBUTION:

SDL 040, SDL 043, SDL 410, SDL 412 (LaRC Safety Manual Holders)
429/ Safety and Facility Assurance Office, OSSEMA (200 Copies)

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Chapter 1**1. INTRODUCTION****1.1 BACKGROUND**

Every effort shall be made to ensure that the work environment affords the necessary protection against musculoskeletal disorders (MSDs). MSDs may develop in workers whose jobs involve repetitive motions, force, awkward postures, contact stress, cold temperatures, excessive duration, and vibration.

The principle behind ergonomics is that by fitting the job to the worker through adjusting the workstation, rotating between jobs, taking frequent breaks, or using mechanical assistive devices, MSDs can be reduced and ultimately eliminated.

The aim of this procedural requirement is to:

- Identify work practices and operations which may lead to MSDs
- Prevent musculoskeletal disorders among employees
- Provide a work environment free from ergonomic hazards; and to

give priority to engineering and administrative controls to the greatest extent practicable to eliminate, or control work operations that may lead to the development of musculoskeletal disorders.

Ergonomic-related injuries are usually associated with prolonged exposure to inappropriate work conditions or practices rather than acute exposure injuries such as sprains and strains.

1.2 ISSUANCE AND CONTROL

The Safety and Facility Assurance Office (SFAO) is responsible for the issuance, distribution, and control of these procedural requirements. Revisions shall be reviewed with affected organizations and documented on a Transmittal Notice.

1.3 GUIDANCE, DEFINITIONS, AND TERMINOLOGY

Appendices A, "Guidance," C, "Definitions and Terminology," and D, "Acronyms," are included to assist with these procedural requirements.

Chapter 2**2. RESPONSIBILITIES****2.1 ERGONOMICS PROGRAM OFFICER (ErgPO)**

The LaRC Industrial Hygienist is the ErgPO and is responsible for:

- a. Implementing and administering the Ergonomics Program (EP).
- b. Evaluating levels of employee exposure to ergonomic hazards and recommending means of controlling exposures.
- c. Ensuring that personnel are instructed, individually or in groups, by qualified personnel concerning the health hazards associated with repetitive motions, force, awkward postures, contact stress, cold temperatures, excessive duration, and vibration and methods to mitigate them.
- d. Maintaining survey data relative to MSD hazards and employee exposures.
- e. Conducting an annual review to ensure that employee training is adequate.
- f. Making recommendations to the Occupational Medicine Clinic (Health Clinic) on the placement or reassignment of personnel with significant musculoskeletal disorders, after conferring with the Occupational Health Officer (OHO), Office of Human Resources (OHR).
- g. Providing ergonomics consultative services.
- h. Conducting follow-up evaluations for personnel who have reported to the clinic for MSDs and for personnel who have modifications made to their work place in response to a MSD complaint.

2.2 OCCUPATIONAL MEDICINE CLINIC (HEALTH CLINIC)

The Health Clinic, OHR, is responsible for:

- a. Obtaining work histories in support of the EP, and evaluating test results.
- b. Scheduling and conducting appropriate medical examinations, and/or referring personnel to an appropriate medical consultant.
- c. Notifying the employee's supervisor if a change in job assignment or workstation layout is recommended as a result of a musculoskeletal disorder.
- d. Notifying and coordinating with the ErgPO when an employee reports with a MSD.

2.3 ERGONOMIC EVALUATORS (ERGO EVALUATORS)

These individuals are the backbone of the LaRC ergonomics program providing assistance in recognizing problems and recommending solutions. Approximately 40 people (1% of the population) from various levels within the organizations at LaRC serve as Ergo Evaluators. Ergo Evaluators are responsible for:

- a. Attending training to develop knowledge and expertise in ergonomic principles through lecture and hands-on technical exercises.
- b. Scheduling and conducting worksite evaluations as requested.
- c. Notifying the employee's supervisor if a change in workstation layout is recommended.
- d. Educating co-workers on the principles of ergonomics.
- e. Proactively addressing ergonomic stressors they identify during the normal course of their workday.
- f. Requesting assistance from the ErgPO if they are unsure of proper workstation setup or work practices.

2.4 SUPERVISORS

Supervisors are responsible for:

- a. Providing the ErgPO and the Health Clinic with the names of personnel with possible MSDs.
- b. Referring to the LaRC Health Clinic for examination and follow-up, all personnel complaining of possible MSDs.
- c. Enforcing the wearing of personnel protective devices (such as vibration dampening gloves, knee pads, and computer glasses) to reduce the effects of MSDs on the employee.
- d. Reviewing employee work activities and identifying tasks, or locations, which may pose an MSD risk.
- e. Abating identified MSD hazards.
- f. Assuring that employees report to the clinic any suspected MSDs.

- g. Assuring the procurement (including credit card purchases) of appropriate Personal Protective Equipment (PPE) and other ergonomic devices by obtaining the approval of the ErgPO. However, PPE will only be used when engineering controls or administrative controls are not feasible.
- h. Notifying the ErgPO of new or previously un-reviewed work activities that are likely to result in MSDs so that ergonomic assessments can be made.

2.5 EMPLOYEES

Employees are responsible for:

- a. Notifying their supervisor of activities that may present a risk for MSDs.
- b. Reporting to the clinic for evaluation if they believe that they may be experiencing symptoms of a MSD.
- c. Performing work with ergonomic considerations in mind. This includes establishing work areas in a manner consistent with good ergonomic practices.
- d. Requesting assistance from an Ergo Evaluator or the ErgPO if they are unsure of proper workstation setup or work practices.
- e. Assisting in identifying and recommending corrective actions for ergonomic hazards.

APPENDIX A Guidance

The procedures for implementing the Ergonomics Program are presented in this chapter. The procedures include training of supervisors and employees regarding common MSDs and the signs/symptoms of exposure, the procedures for evaluating employee workstations for ergonomic hazards, use of ergonomic devices to reduce the likelihood and severity of MSDs, and recordkeeping.

A.1 MSD HAZARD EVALUATION

MSD hazard evaluation includes identifying workstation layout and work practices, which are likely to result in MSDs.

A.1.1 WORK STATION EVALUATIONS

Any employee who is experiencing discomfort or is concerned about their workstation may request an evaluation. Evaluations may also be requested by supervisors or by the Health Clinic in response to a suspected MSD. Workstation evaluations are performed by the ErgPO or other qualified individuals.

Copies of the results of the evaluations, along with the recommended actions, should be distributed to the employee, their supervisor, the Occupational Medicine Clinic (Health Clinic), and the ErgPO.

Employees are also encouraged to perform evaluations of their own workstations. (See Langley Form 19, "Office Ergonomics Evaluation Checklist.")

A.2 OFFICE ENVIRONMENTS

MSD-related injuries in the office environment are most often associated with poor workstation arrangement and excessive computer usage without taking breaks. These injuries can be prevented through proper workstation design and the use of micro-breaks.

A.2.1 ENGINEERING CONTROLS

Engineering controls are always the preferred method for controlling hazards. In office environments, the primary method of control is the selection of appropriate furniture and the proper position of the furniture and office equipment in relation to the worker.

The following describes the proper method for selection and use of office equipment:

A.2.1.1 CHAIRS

When purchasing chairs, the chair selected should be fitted to the individual who will be using it. In general chairs should be highly adjustable, allowing adjustment of the following: seat height and tilt, armrest height and width and back rest height. Chairs being purchased to address ergonomic concerns should have good lumbar support, have a five-point star base and wheels appropriate for the floor surface. The chair height should be positioned such that the thighs are roughly parallel to the floor with the feet flat on the ground, preventing pressure on the back of the lower thigh. It may be necessary to use a footrest to achieve proper positioning. If the seat tilt is adjustable it should be set for a slight forward tilt. The back height and angle should be set so that it provides good lumbar support. The armrests should be set so that the elbows are directly below the shoulders. Existing chairs will be used until unserviceable unless there are indications that their use will lead to an MSD.

A.2.1.2 WORK SURFACES

Work surfaces should be of a height such that the workers forearms are roughly parallel to the floor and deep enough to accommodate all necessary equipment such as monitors and keyboards. Additionally, the working position should not require the workers forearms or wrists to contact any sharp corners. Articulated keyboard trays can be used to provide adjustability to workstations.

A.2.1.3 COMPUTER INPUT DEVICES

Keyboards should be located directly in front of the worker at a height allowing their forearms to be roughly parallel to the floor. In addition, the angle of the keyboard should allow the wrists to maintain a neutral position. In general, this means that the keyboard should not be tilted toward the worker and may in fact need to be tilted slightly away from the worker.

Computer mice and trackballs should be positioned so that the worker can use them without having to reach with the shoulder. Mice should be of a size that comfortably fits in the palm of the hand. Mice should not require the user to grip them tightly in order to use them. Avoid small "hockey puck" mice as they require a gripping motion to use them.

Wrist rests should be used with both keyboards and mice/trackballs. The hands should float above the keyboard and the wrist rests should be used during periods of inactivity.

A.2.1.4 COMPUTER MONITORS

Computer monitors should be positioned directly in front of the worker. The height of the monitor should be set so that the top third of the monitor is at the height of level

vision. Reams of paper are an inexpensive way to raise monitors, however care should be taken to avoid a tipping hazard. The distance of the monitor should be at about the end of arms reach when sitting in working position.

A.2.1.5 LIGHTING

Room lighting should be bright enough to prevent eyestrain. Computer monitors should be positioned to eliminate glare from overhead lighting or windows. Individual bulbs may be removed from overhead lights to control lighting intensity and glare. The use of task lighting is effective for creating areas of localized lighting without increasing the overall brightness of a room.

A.2.1.6 VISION

Vision is an, often, overlooked factor in office ergonomics. Prolonged computer usage without taking frequent breaks can cause eyestrain. Frequent “microbreaks” are recommended where the worker simply changes their depth of focus for a short period of time.

Workers who wear corrective lenses for vision are at additional risk due to the difference in reading and computer monitor distances. The focal length for most reading eyewear is set to approximately 18 inches. Since computer monitors are usually set at farther distances this can cause eyestrain, and in many cases causes the worker to unconsciously hunch forward in order to find their focal length. This can result in neck and shoulder strain. Eyewear can be obtained with the correct focal length for computer use.

A.2.2 ADMINISTRATIVE CONTROLS

Administrative control measures include:

A.2.2.1 BREAKS

Taking frequent breaks is perhaps one of the easiest ways to prevent injuries associated with prolonged computer usage. A break of a few minutes should be taken every half hour while using the computer. Studies have shown that it is effective in preventing injury and that productivity and accuracy are actually improved as a result of the frequent breaks.

A.2.2.2 ROTATION OF REPETITIVE TASKS

Tasks that involve repetitive motions can be rotated between employees in order to lessen the exposure to individuals.

A.2.3 PROTECTIVE EQUIPMENT

Protective equipment, such as braces, should not be used unless recommended by a medical professional. Do not attempt to treat symptoms yourself by buying over the counter braces or splints. Improper selection of protective equipment can encourage continuing poor work practices and lead to further injury. Report any symptoms of MSDs to the clinic.

A.3 INDUSTRIAL ENVIRONMENTS

MSD injuries in industrial environments can occur from improper lifting and material movement techniques, from performing repetitive tasks and from using hand tools. As each industrial environment is unique only general guidance can be provided regarding evaluation of these types of worksites.

A.3.1 ENGINEERING CONTROLS

The use of engineering controls is always the preferred method to control hazards. The primary engineering controls for industrial type setting are the use of proper material handling equipment and design of work areas to prevent awkward or stressful positions or motions. The selection of ergonomically designed hand tools is also important.

A.3.1.1 MATERIAL HANDLING

The selection of proper handling equipment can be complex and should be made in consultation with knowledgeable personnel. Situations in which material-handling aides should be considered include the movement of large, heavy or awkwardly shaped items, and work environments where employees repeatedly perform lifts. Manual lifting requirements are discussed in Section A.3.2.1.

Common material handling equipment includes pallet jacks, pump-jack tables and mechanical lifting aides, such as vacuum lift assist devices.

A.3.1.2 WORK AREA DESIGN

When designing industrial work areas consideration needs to be made for the types of tasks to be performed. Shelves and parts bins should be placed at heights that keep loads at the proper working height and do not require excessive reaching and the active working area should be directly in front of the worker.

Work surfaces such as benches should also be kept at heights consistent with the working position of the employee (e.g., sitting or standing). Standing work locations should have floor mats and stools to increase worker comfort.

A.3.1.3 TOOL SELECTION

Selecting appropriate hand tools can greatly increase worker comfort and prevent injuries associated with gripping small objects. Tool handles should allow workers to keep a neutral position during use and be large enough to grip comfortably. Hand tools should be well balanced to reduce the amount of torque on the wrist. Do not use tools with finger grooves molded into them, there is no standard hand or finger size and these tools are likely to cause unnecessary pressure from the grooves.

Vibrating power tools have the ability to cause nerve injury. Whenever possible tools with built in vibration dampeners should be selected. Tools handles should be comfortable to grip and padded when possible. Tool handles should also be set at an angle consistent with their use position. As an example, consider installing screws: To install screws vertically above waste level, using an electric screwdriver with a handle that is on the same plane as the screw will allow the wrist to maintain a neutral position.

A.3.2 ADMINISTRATIVE CONTROLS

Administrative controls include:

A.3.2.1 LIFTING TECHNIQUES

When lifting objects care should be taken to use proper lifting techniques in order to avoid back injuries. **More than one person should be used to lift objects that weigh more than 40 pounds, are large, or are awkwardly shaped.**

If lifting from the ground, start the lift in a squatting position with the item between the knees. Use handles if provided, otherwise position the hands in locations that will provide adequate support. Pick the item up off the ground and straighten the legs keeping the back straight. Keep the item as close to the body as possible and at about waist level while moving it.

When moving items from elevated surfaces ensure that the lift starts as close to the body as possible and do not twist the body while lifting.

A.3.2.2 ROTATION OF DUTIES

Rotate lifting duties among personnel who are physically capable of performing the lifts.

A.3.3 PROTECTIVE EQUIPMENT

The use of protective equipment, such as back braces or lifting belts, is not recommended by NIOSH and should not be used unless recommended by a medical professional.

A.4 LABORATORY ENVIRONMENTS

Laboratory environments present some unique challenges that must be addressed on a case-by-case basis. In most cases they can be considered to be a combination of office and industrial environments and the principles previously described can be applied.

A.5 NON-WORKPLACE ENVIRONMENTS

MSDs occur as a result of chronic exposure to improper working positions or techniques. Many people engage in activities outside of the work place that can pose ergonomic risks. Examples include: computer use, painting and drawing, woodworking, working on automobiles and other mechanical equipment and gardening. It is very important to note that these exposures are additive to the exposure at work. This can even lead to personnel having a MSD injury that will be difficult to diagnose the cause of and correct since the exposure condition will not occur in the workplace.

The principles used to prevent MSD injuries at work also apply to non-work settings.

A.6 TRAINING

Ergonomic Concerns are addressed in the Annual Training that is provided for all supervisors working at LaRC. On-line training programs and site-specific training by SFAO personnel are also available. Training includes the following items:

- Common musculoskeletal disorders (MSD)
- Signs and symptoms of MSDs
- Correct workplace design and proper work habits

A.7 ADDITIONAL INFORMATION

The Internet contains many resources regarding ergonomics, some of which are high quality, some of which are not. The following sites have been evaluated and are recommended resources:

- Occupational Safety and Health Administration (OSHA): www.osha-slc.gov/SLTC/ergonomics/index.html
- National Institute for Occupational Safety and Health (NIOSH): www.cdc.gov/niosh/homepage.html
- Repetitive Stress Injury Information: www.MSDnews.com/
- University of California at Los Angeles Ergonomics Program: www.ergonomics.ucla.edu
- Cornell University Ergonomics Web: <http://ergo.human.cornell.edu/>

- United States Army Center for Health Promotion and Preventive Medicine (USACHPPM) Ergonomics Program: <http://chppm-www.apgea.army.mil/ergopgm/ergohome.htm>
- Department of Defense Ergonomics Working Group: <http://www.ergoworkinggroup.org/myweb/IndexFrames/index2.htm>

Appendix B Ergonomic injuries and their symptoms

The following are common ergonomic injuries and their common symptoms. This list is not exhaustive and **should not** be used for self-diagnosis of an injury. It is merely a guide to understanding the warning signs of MSDs. Individuals experiencing symptoms should seek professional medical advice.

Injury	Symptoms
Carpal tunnel syndrome	Symptoms include tingling, numbness and burning sensation in the thumb, index and/or middle finger. Aching sensation and wrist pain (often at night) are also common. It is caused by compression of the median nerve which runs through the middle of the wrist
Tendonitis	Symptoms include pain, tenderness, swelling and /or weakness of the hand, arm or shoulder. Redness of the hand or wrist may also occur. It is caused by the tendons of the wrists, hands, or shoulder becoming inflamed from overstretching or constriction.
Tenosynovitis	Symptoms include swelling, pain and/or tenderness of the hand. It is caused by inflammation of the tendon and the sheath that it passes through.
DeQuervains disease	This disease is a progressive constriction of the tendon sheath, affecting the tendons on the side of the wrist and base of the thumb. Symptoms include pain and difficulty in moving the thumb.
Rotator cuff injury	Caused by inflammation of one or more of the rotator cuff tendons in the shoulder, symptoms include pain and limited mobility of the shoulder.
Raynoud's syndrome (White finger)	Caused by damage to blood vessels in the finger from use of vibrating tools, especially in cold climates. Symptoms include paleness, tingling or burning sensation in the fingers.
Epicondylitis (Tennis elbow)	Tendonitis of the elbow. Symptoms include pain, swelling and/reduced mobility of the elbow.
Trigger finger	This is due to swelling in the tendon sheaths of the finger causing the tendon to lock in the sheath. It results in snapping or jerking movement when attempting to move the finger.
Synovitis	Swelling of the bursae (fluid filled sac's used to cushion movement) in the knee, elbow, or shoulder.
Back Injuries	Static postures can add a tremendous amount of pressure to the back muscles and spinal discs. Sitting in a slouched position can overstretch the spinal ligaments and strain the spinal discs. A load that slips or shifts as it is being lifted, and a slip and fall can jolt the back with resulting muscle strain or tearing of soft tissue in the back.

Appendix C Definitions and Terminology

- Cold Temperatures - reduce blood flow throughout the body and decreases tactile feedback. Reduced blood flow minimizes the nutrients that travel to the muscles. Reduced tactile feedback will cause the hands to work harder than they have to.
- Compression/Contact Stress - any outside object coming into contact with the body causes compression. Items such as a hard edge, sharp surface, corner, or excessive weight can cause damage to the body's soft tissues (nerves, tendons, blood vessels, etc.).
- Duration - the length of any period of work activity which poses a MSD risk. The longer the duration task the greater the exposure and the greater the risk of an MSD.
- Ergonomics - the application of knowledge about human capacities and limitations to the design of workplaces, jobs, tasks, tools, equipment, and the environment.
- Frequency - the rate at which you repeat specific physical motions or exertions
- Force - physical exertion by or pressure applied to any part of the body to move, direct, or operate equipment. The less force required to operate equipment the less traumatic it is to the body. Ideally we want all systems to require a minimum of force.
- Musculoskeletal disorders (MSDs) - work-related disorders caused by improper job, tool, and workstation design, by application of excessive force on the body, or by unusual postures. In general, the term MSD only applies to injuries received from chronic exposures rather than acute injuries such as strains and sprains. Other terms commonly associated with MSD are Cumulative Trauma Disorder (CTD) and Repetitive Stress Injury (RSI).
- Posture - the position of any part of your body during a work activity. Neutral postures are important because they maximize the amount of strength a worker can exert, maximizes worker comfort, and minimizes the risk of worker injury.
- Repetition - Repetition or use of the same body parts continuously throughout the workday is damaging to the body. Micro traumas from repetition can result in inflammation of the tendons, muscle irritation or entrapment syndromes, and nerve irritation. Prolonged exposure to repetitive motions can result in even more traumatic injuries.
- Segmental Vibration - Segmental vibration affects a part of the body, the most common type of segmental vibration is hand-arm, it is usually cause by a worker holding a vibrating hand tool for a long period of time. This action causes reduced blood flow to the fingers and can lead to blanching of the fingers.

- Whole Body Vibration - Segmental vibration affects a part of the body, the most common type of segmental vibration is hand-arm, it is usually cause by a worker holding a vibrating handtool for a long period of time. This action causes reduced blood flow to the fingers and can lead to blanching of the fingers.

Appendix D Acronyms

EP	Ergonomics Program
ErgPO	Ergonomic Program Officer
LaRC	NASA Langley Research Center
MSD	Musculoskeletal disorder
OHR	Office of Human Resources
OMC	Occupational Medicine Clinic
PPE	Personal Protective Equipment
SFAO	Safety and Facility Assurance Office