FALL PROTECTION PROGRAM

INTRODUCTION

The nature of work activities at Fermilab exposes workers to a variety of fall hazards while performing inspection, service, maintenance, repair, experiment support, and building remodeling projects. The first approach to fall protection safety is to prevent a fall from occurring. When fall prevention is not possible, fall protection in the form of fall positioning, fall restraint or a personal fall arrest system is required in accordance with Title 29 of the Code of Federal Regulations Parts 1910 and 1926.

One hazard that comes as a result of a fall while wearing a harness is that of orthostatic intolerance. Following a fall, a worker may remain suspended in a harness. Depending on the length of time the suspended worker is hanging, the worker may sustain injuries resulting from orthostatic intolerance, which could ultimately lead to death. For this reason when planning a job involving the use of fall protection, where a worker could become suspended, a rescue action must be identified.

POLICY

Any employee, visiting scientist, or user involved in work activities and exposed to a fall hazard at or greater than four (4) feet must be trained to recognize fall hazards and the selection and use of fall prevention, fall restraint equipment or personal fall arrest equipment. For construction activities, the fall hazard cannot be at or greater than six (6) feet.

29 CFR 1910 and 29 CFR 1926 shall be followed when the work involves hazards that require fall protection. Exceptions to fall protection requirements, as provided in 29CFR 1926.500, are ONLY for construction-related activities.

Individuals whose weight falls outside the range of 130 to 310 pounds will require additional work planning before wearing fall protection. Consult with your division/section Senior Safety Officer (SSO) in these situations.

A written Hazard Analysis is required for any work activities requiring the use of fall arrest systems where there is the potential for a person to be suspended after a fall arrest event.

REFERENCES

29 CFR 1910, General Industry Standards (Specific subparts are referenced in the flow diagram found in the TA-5066-1)

29 CFR 1926, Subpart M- Construction Standards (Fall Protection)

FESHM 2060, Work Planning and Hazard Analysis

FESHM 1030, Environmental, Safety, and Health Organization and Responsibilities

Z359.0-2007 – Definitions and Nomenclature Used for Fall Protection and Fall Arrest

Z359.1-2007 – Safety Requirements for Personal Fall Arrest Systems, Subsystems and Components

Z359.2-2007 – Minimum Requirements for a Comprehensive Managed Fall Protection Program

Z359.3-2007 – Safety Requirements for Positioning and Travel Restraint Systems

Z359.4-2007 – Safety Requirements for Assisted-Rescue and Self-Rescue Systems, Subsystems and Components

ANSI A10.32-2004 – Fall Protection Systems – American National Standard for Construction and Demolition

DEFINITIONS

Anchorage – A secure point of attachment for lifelines, lanyards or deceleration devices able to withstand 5000 pounds of dead weight per person for fall arrest and 1000 pounds for fall restraint.

ANSI – American National Standards Institute

Body Harness - Straps which may be secured about the worker in a manner that will distribute the fall arrest forces over at least the thighs, pelvis, waist, chest and shoulders with means for attaching it to other components of a personal fall arrest system.

Capacity (CAP) – The combined weight for which the component is designed to be used. Combined weight includes the user's body weight and clothing, tools, and other objects borne or carried by the user.

Carabiner – A connector component generally comprised of a trapezoidal or oval shaped body with a normally closed gate or similar arrangement which may be opened to permit the body to receive an object and, when released, automatically closes to retain the object. It has a self closing mechanism that requires at least two consecutive deliberate actions to open.

Certification – An act or process resulting in documentation that determines and attests to criteria that meet the requirements of ANSI Z359.1. Such act or process may be carried out by testing or applying proven analytical methods, or both, under the supervision of a qualified person or entity.

CFR – Code of Federal Regulations

Competent Person - A person who is capable of identifying hazardous or dangerous conditions in any personal fall arrest system or any component thereof, as well as in their application and use with related equipment.

Connector - means a device which is used to couple (connect) parts of the personal fall arrest system and positioning device systems together. It may be an independent component of the system, such as a carabiner, or it may be an integral component of part of the system (such as a buckle or D-ring sewn into a body harness, or a snap-hook spliced or sewn to a lanyard or self-retracting lanyard).

Construction - Means construction, alteration, demolition, or repair (including dredging, excavating, and painting) of buildings, structures or other real property. For purposes of this definition, the terms "buildings, structures, or other real property" include, but are not limited to, improvements of all types, such as bridges, dams, plants, highways, parkways, streets, subways, tunnels, sewers, mains, power lines, cemeteries, pumping stations, railways, airport facilities, terminals, docks, piers, wharves, ways, lighthouses, buoys, jetties, breakwaters, levees, canals, and channels. Construction does not include the manufacture, production, furnishing, construction, alteration, repair, processing or other kinds of personal property.

Deceleration Device - Any mechanism with a maximum length of 3.5 feet, such as a rope grab, rip stitch lanyard, tearing or deforming lanyards, self-retracting lifelines, etc. which serves to dissipate a substantial amount of energy during a fall arrest, or otherwise limit the energy imposed on the worker during fall arrest.

Deceleration Distance - means the additional vertical distance a falling worker travels, excluding lifeline elongation and free fall distance, before stopping, from the point at which the deceleration device begins to operate. It is measured as the distance between the location of a worker's body belt or body harness attachment point at the moment of activation (at the onset of fall arrest forces) of the deceleration device during a fall, and the location of that attachment point after the worker comes to a full stop. See Technical Appendix 4 for calculating total fall distance.

Fall Protection System - A barrier erected to prevent workers from falling to lower levels. It can also be a system/procedure intended to prevent workers from falling off, onto or through working levels.

Fall Restraint System - means a fall protection system that prevents the user from falling any distance. The system is comprised of a body harness, along with an anchorage, connectors and other necessary equipment. The other components typically include a lanyard, and may also include a lifeline and other devices.

Free Fall – The act of falling before the personal fall arrest system begins to react by applying force to arrest the fall.

Free Fall Distance - The vertical displacement of the fall arrest attachment point on the worker's body harness between onset of the fall and just before the system begins to apply force to arrest the fall (maximum of 6 feet). This distance excludes deceleration distance, and lifeline/lanyard elongation, but includes any deceleration device slide distance or self-retracting lifeline/lanyard extension before they operate and fall arrest forces occur.

Inspection - The activity of investigating or assessing the condition of equipment, buildings, and property to determine the status and any required actions prior to the commencement of construction work and upon the completion of the work. **Note:** No fall protection is required for inspections conducted under 1926.500 prior to commencement of work or after work is complete.

Lanyard - A flexible line of rope, wire rope, or strap which generally has a connector at each end for connecting the body belt or body harness to a deceleration device, lifeline or anchorage.

Lifeline - A component consisting of a flexible line for connection to an anchorage at one end to hang vertically (VLL) or for connection to anchorages at both ends to stretch horizontally (HLL) and which serves as a means for connecting other components of a personal fall arrest system to the anchorage.

OSHA – Occupational Safety and Health Administration

Personal Fall Arrest System (PFAS) - a system used to arrest a worker in a fall from a working level. It consists of an anchorage point, connectors, a body harness and may include a lanyard, deceleration device, lifeline, or suitable combinations of these. As of January 1, 1998, the use of a body belt for fall arrest is prohibited.

Positioning Device System - means a body harness system rigged to allow a worker to be supported on an elevated vertical surface, such as a wall, and work with both hands free while leaning.

Qualified Person- One with a recognized degree or professional certificate and extensive knowledge and experience in the subject field who is capable of design, analysis, evaluation and specifications in the subject work, project, or product.

Rope Grab - A deceleration device which travels on a lifeline and automatically, by friction, engages the lifeline and locks so as to arrest the fall of a worker. A rope grab usually employs the principle of inertial locking, cam/level locking, or both.

Self-Retracting Lifeline/Lanyard - A deceleration device containing a drum-wound line which can be slowly extracted from, or retracted onto, the drum under slight tension during normal worker movement, and which, after onset of a fall, automatically locks the drum and arrests the fall.

Work Activities – All work performed throughout the Lab that has not been deemed construction.

RESPONSIBILITIES

Divisions/Sections/Centers are responsible for:

- Identifying activities that present a fall hazard to their workers under their control.
- Assigning a competent person to review the work, developing a hazard analysis, and implementing internal procedures.
- Assuring workers are trained in fall protection measures.
- Incorporating fall protection requirements into designs for new and retrofitted equipment as well as planned and existing structures where known or predictable fall hazards are expected to occur.
- Involving a qualified person when load rating of anchorage points must be determined or is in doubt.

- Conducting and documenting a yearly inspection of all personal fall arrest systems and components.
- Identifying anchor points in buildings or installing new ones where necessary in accordance with the policy.

Task Managers/Construction Coordinators/Service Coordinators are responsible for:

- Verifying that fall protection training was completed for subcontractor workers who will/are exposed to a fall hazard
- Verifying that the subcontractor has a written fall rescue plan in place before any subcontractor worker is exposed to a fall hazard. The fall rescue plan may be part of the written hazard analysis or may be attached to the hazard analysis as a separate document.
- Exchanging information regarding fall hazards and fall protection in Fermilab owned facilities during pre-construction meetings.
- Obtaining information from the subcontractor regarding fall protection methods that the subcontractor will follow while engaged in work activities.

Supervisors are responsible for:

- Defining work as Construction, if applicable..
- Determining applicable standards, precautions, and training per the flow charts in 5066 Technical Appendix 1 – Fall Protection Flow Charts.
- Identifying workers exposed to fall hazards in the Individual Training Needs Assessment (ITNA), and assuring they are trained before using a fall protection device.
- Observing workers while engaged in work at heights and observing protection methods and at-risk behaviors.
- Assuring that fall rescue plans are incorporated into the hazard analysis before a worker is exposed to a fall.

ESH-Safety and Industrial Hygiene Group (SIH) are responsible for:

- Providing consultation to D/S safety departments and personnel upon request.
- Developing, providing and updating fall protection training.
- Assisting divisions and sections in fall protection assessments when requested.

EDUCATION AND TRAINING REQUIREMENTS

Any worker, visiting scientist, or subcontractor involved in work activities and exposed to a fall hazard at or greater than four (4) feet requiring fall restraint, or to a fall hazard at or greater than six (6) feet requiring fall restraint or a personal fall arrest system must be trained and made aware of the fall hazards and the use of fall protection equipment. As a minimum, the training shall include:

- Recognition of the hazard,
- The nature of fall hazards in work areas,
- The correct way to use/inspect/maintain fall protection systems,
- Identification of required anchor points, and
- Employee and employer responsibility.

For Fermilab employees and scientific users, this can be accomplished by completing FN000304- Fall Protection Training. To remain qualified, they must also attend refresher training in fall protection principles and practices every two years. This training may be classroom based or computer based.

WORK PLANNING AND FALL RESCUE

A written Hazard Analysis is required whenever the free fall distance could result in the worker left in a suspended position. A fall rescue plan must be included in the HA and shall include emergency procedures, methods of rescue, and equipment required for a timely rescue to prevent the consequences of orthostatic intolerance.

A rescue plan may include one or more approaches to provide protection against fall hazards. Some of these approaches are:

- Self-rescue
- Buddy rescue
- Contacting the Fermilab Fire Department before work starts. Inform the FFD of where their site is located and what some of the potential access problems are, as well as find out how long it would take for an ambulance or fire truck to get to the site before a fall occurs. Ask the fire department, if necessary, to come to the job site to assess any specific job risks. Notify the Fermilab Fire Department once the work is complete.

Information to consider for the fall rescue plan:

- What is the emergency contact information, such as the Fermilab Fire Department, and what are the instructions for summoning immediate assistance?

- Is rescue equipment immediately available for this location? (Ladders, aerial devices, elevating work platforms, tripods, additional harnesses, controlled descent devices, winches, pulleys, etc.)
- What obstructions are in the way reaching the suspended worker?
- How will rescue be assured within 15 minutes of the occurrence of a fall to minimize the risk of further injury or death due to suspension trauma?
- How will the safety of the rescuers be assured as well as that of the suspended worker?
- What communication systems will be used between the suspended worker and rescue team?

FALL PROTECTION SYSTEMS

The following is a list of the various types of fall protection systems that may be used at Fermilab. See 5066 Technical Appendix 3 – Fall Protection Equipment –Selection and Use for additional information.

Permanent Facilities Work Platforms

Fall prevention is required when workers are working off a permanent platform and the height from the platform surface to the lower level is at or above four (4) feet but less than six (6) feet. Fall prevention is achieved by installing railings on the platform and on the stairs leading to the platform. Fall prevention can also be achieved by installing a restraint system if the installation of railings is not feasible. At six feet or higher, either fall prevention or fall protection may be used.

Fall Restraint System

This system consists of a harness or belt, a non-shock absorbing lanyard or restraint line and anchorage point. It will allow a worker to approach a fall hazard and work with both hands free, and yet not allow the worker to fall any distance. The harness must be attached to securely rigged restraint lines. The anchorage should be able to withstand a minimum force of 1000 pounds or twice the maximum expected force that is needed to restrain the person from exposure to the fall hazard.

Restraint protection shall be rigged to allow the movement of workers only as far as the sides and edges of the walking/working surface.

Custom Made Fall Protection Systems

There may be instances where a work process and the environment do not lend themselves to using commercially available equipment. In these cases, the division or

section may design a fall protection system in-house or procure custom designed systems from several companies that engage in this kind of service. However, there are steps that must be taken to ensure that the system meets all the parameters required by the performance standards within OSHA and ANSI.

1) Fermilab Designed Systems

A Fermilab qualified engineer may design a system and oversee the installation. Acceptance of the system requires an engineering note that must be created and accepted. The engineering note must also include installation specifications.
Excluded from the requirement are systems designed as part of new construction or modifications that are included in engineering drawings and specifications and signed by a Fermilab professional engineer; or, a professional engineer from an A&E firm under contract to Fermilab.

Oversight over the installation of the system may be by the designer or by a qualified task manager or construction coordinator. The task manager or construction coordinator must create and sign a document certifying that the installation followed the specifications laid out by the designer. The original certification will be sent to the ESH Section to be attached to the engineering note and filed.

2) Commercially Designed Systems

Systems designed by companies who specialize on fall protection systems must also follow similar rules as systems designed by a Fermilab engineer. The company must provide a product sheet that describes the system as meeting the OSHA and ANSI standards for fall protection. Installation specifications must also be provided. Installation of the system must be by subcontractors who are qualified to do so.

These custom designed systems are subject to yearly inspections by a qualified person. Inspections must be documented. The qualified person may be a Fermilab employee or a subcontractor meeting the definition.

WORKING FROM ARTICULATING AND OR TELESCOPING BOOM LIFTS

Anyone working from a telescoping and or articulating boom lift, commonly known as JLG lifts, or bucket trucks, must wear a personal fall arrest system attached to the manufacture's designated anchorage point.

The use of a personal fall arrest system is not required on scissor lifts if the guardrail system is intact.

EQUIPMENT INSPECTION

To maintain their service life and high performance, all harnesses, lanyards and lifelines should be visually inspected before each use. In addition, a division/section competent person shall inspect the equipment every 12 months and document the inspection. If the equipment is found to be deficient, it shall be replaced immediately. It is the policy of Fermilab to remove any harness or synthetic lanyard from service five years after it has been put into service.

All components of a personal fall arrest system shall be removed from service if subject to a fall.

Marking or writing on the webbing of harnesses for identification purposes can only be done with the "Sharpie" brand of felt-tip marking pens from Sanford, Inc. This is the only brand of marker that has tested and approved. If you need another way to mark your harness, most harnesses have a blank label in the back of the label pack to use for identification. Any permanent marker will work when using the blank label.
TA-5066-2 provides specific guidance in conducting these inspections.

AUDITS AND EVALUATION

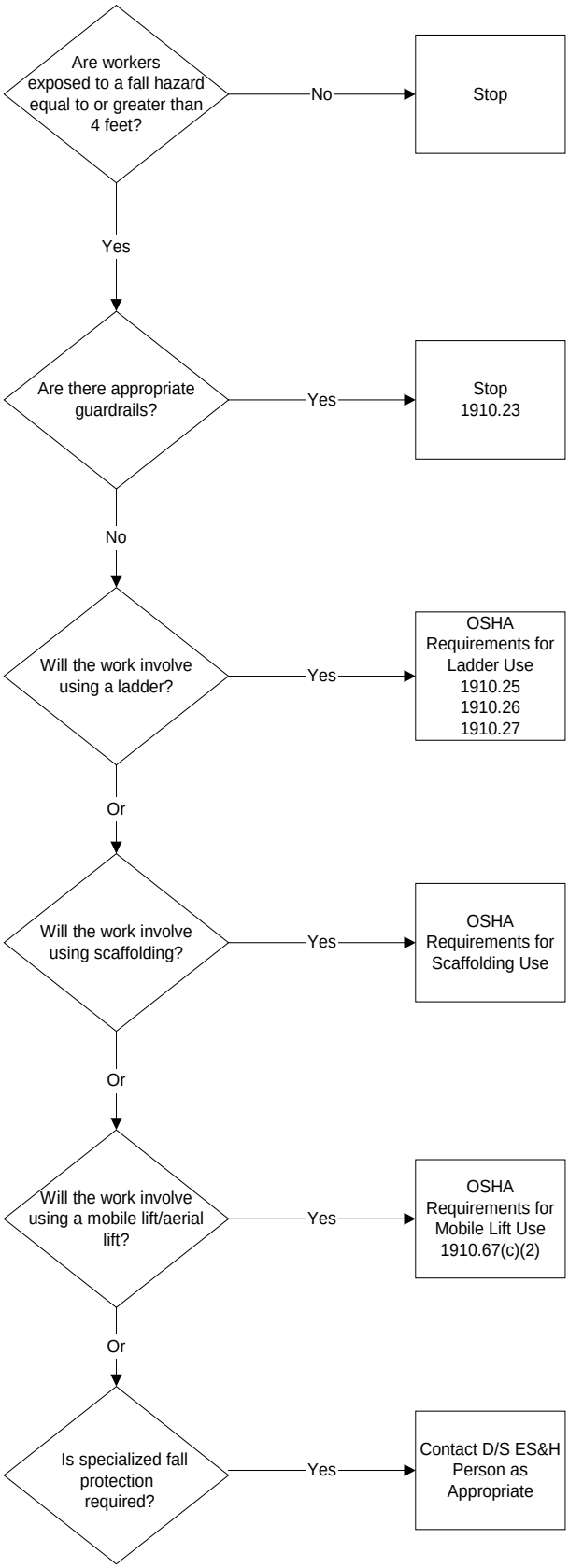
<u>Division/Section Evaluation of Fall Protection</u>

An internal assessment of the implementation of this chapter for oversight purposes should be conducted as part of the division/section self-assessment program (FESHM 1030). This can be accomplished with the tri-partite assessment process or even sooner at the discretion of the organization. Some suggested audit points are listed below.

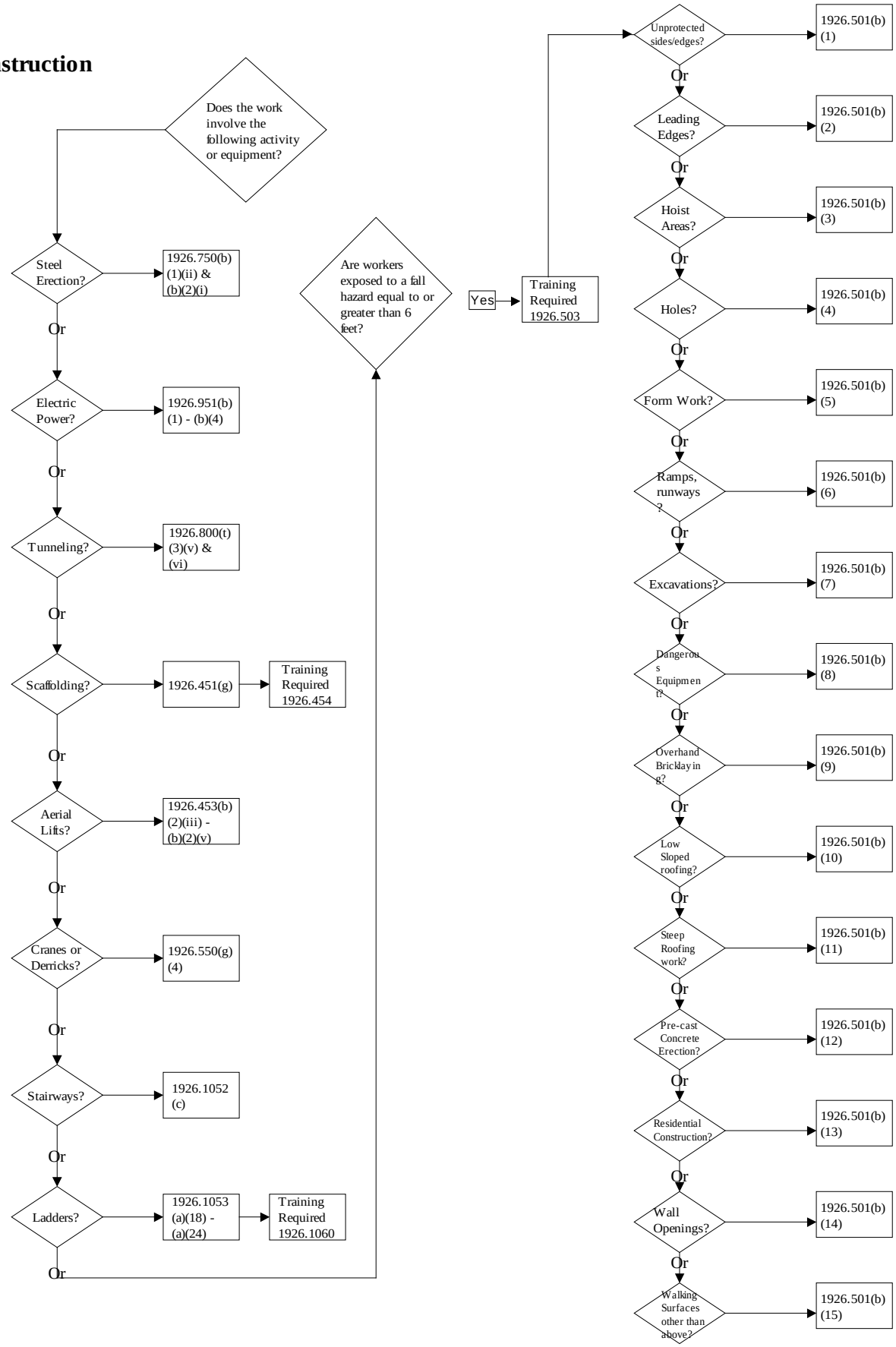
1) Verification of training or refresher training of D/S members.
2) Inspection, use and care of equipment.
3) Proper use of the equipment.
4) Inspection of custom designed and installed systems for any deterioration.
5) Identification and evaluation of fall protection hazards not previously recognized.
6) Random interviews with D/S members to determine degree of understanding of fall protection measures and the need for refresher training.

Technical Appendix 1- Fall Protection Flow Charts

Maintenance and Operations



Construction



Technical Appendix 2
Inspection, Storage, Care and Maintenance of Equipment- Guidance

Manufacturer's instructions shall be retained on file for reference.

Harness Inspection

Belts and Rings

1. For a harness, inspections begin at one end. Hold the body side of the belt toward you, grasping the belt with your hands six to eight inches apart. Bend the belt in an inverted "U." Watch for frayed edges, broken fibers, pulled stitches, cuts or chemical damage. Check D-rings and D-ring metal wear pads for distortion, cracks, breaks, and rough or sharp edges. The D-ring bar should be at a 90 degree angle with the long axis of the belt and should pivot freely.

2. Attachments of buckles and D-rings should be given special attention. Note any unusual wear, frayed or cut fibers, or distortion of the buckles. Rivets should be tight and irremovable with fingers. Body side rivet base and outside rivets should be flat against the material. Bent rivets will fail under stress.

3. Inspect frayed or broken strands. Broken webbing strands generally appear as tufts on the webbing surface. Any broken, cut or burnt stitches will be readily seen.

4. Tongue Buckle: Buckle tongues should be free of distortion in shape and motion. They should overlap the buckle frame and move freely back and forth in their socket. Rollers should turn freely on the frame. Check for distortion, sharp edges, loose, distorted, or broken grommets.
5. Friction Buckle: Inspect the buckle for distortion. The outer bar or center bars must be straight. Pay special attention to corners and attachment points of the center bar.

Lanyard Inspection

When inspecting lanyards, begin at one end and work to the opposite end. Slowly rotate the lanyard so that the entire circumference is checked. Spliced ends require particular attention. Hardware should be examined under procedures detailed below.

1. Web Lanyard

   While bending webbing over a piece of pipe, observe each side of the webbed lanyard. This will reveal any cuts or breaks. Due to the limited elasticity of the web lanyard, fall protection without the use of a shock absorber is not recommended.

2. Rope Lanyard

Rotation of the rope lanyard while inspecting from end to end will bring to light any fuzzy, worn, broken or cut fibers. Weakened areas from extreme loads will appear as a noticeable change in original diameter. The rope diameter should be uniform throughout, following a short break-in period. When a rope lanyard is used for fall protection, a shock-absorbing system should be included.

3. Shock-Absorbing Packs

The outer portion of the shock-absorbing pack should be examined for burn holes and tears. Stitching on areas where the pack is sewn to the D-ring, belt or lanyard should be examined for loose strands, rips and deterioration.

4. Visual Indication of Damage to Webbing and Rope Lanyards

Heat - In excessive heat, nylon becomes brittle and has a shriveled brownish appearance. Fibers will break when flexed and should not be used above 180 degrees Fahrenheit.

Chemical - Change in color usually appears as a brownish smear or smudge. Transverse cracks appear when belt is bent over tight. This causes a loss of elasticity in the belt.

Ultraviolet Rays - Do not store webbing and rope lanyards in direct sunlight. Ultraviolet rays can reduce the strength of some materials.

Molten Metal or Flame - Webbing and rope strands may be fused together by molten metal or flame. Watch for hard, shiny spots or a hard and brittle feel. Webbing will not support combustion, nylon will.

Paint and Solvents - Paint will penetrate and dry, restricting movements of fibers. Drying agents and solvents in some paints will appear as chemical damage.

Hardware - Inspect snap hooks closely for hook and eye distortion, cracks, corrosion, scale, pitted surfaces or deposits of foreign matter. The keeper or latch should seat into the nose without binding and should not be distorted or obstructed. The keeper spring should exert sufficient force to firmly close the keeper. Keeper rocks must provide the keeper from opening when the keeper closes.

Thimbles - The thimble (protective plastic sleeve) must be firmly seated in the eye of the splice, and the splice should have no loose or cut strands. The edges of the thimble should be free of sharp edges, distortion, or cracks.

Care and Storage of Equipment

Basic care for fall protection safety equipment will prolong and endure the life of the equipment and contribute toward the performance of its vital safety function. Proper storage and maintenance after use is as important as cleaning the equipment of dirt, corrosives or contaminants. The storage area should be clean, dry and free of exposure to fumes, mists, vapors or corrosive elements.

For nylon and polyester articles, clean according to the manufactures instructions. Drying- Harness, belts and other equipment should be dried thoroughly without exposure to heat, steam or long periods of sunlight.

Intentionally Left Blank

Technical Appendix 3

FALL PROTECTION EQUIPMENT- Selection and Use

Fall protection harnesses are designed for a capacity range of 130 pounds to 310 pounds (59- 140 Kg). This range is selected in order to stay within the maximum arresting force of 1800 pounds directed by government safety regulations. Workers outside these parameters must undergo an evaluation by the respective Division/Section safety department before they are allowed to use a personal fall arrest system. If allowed to use fall arresting gear these workers are restricted to the use of a retractable lanyard.

W A R N I N G

All straps built into the harness must be attached as per the manufacturer's instructions. Leaving the leg straps unhooked may cause the user to slip through and out of the harness with the possibility of serious injury or death.

Hoisting materials with any component of a worker positioning system or with any component of a personal fall arrest system is prohibited.

All components of a personal fall arrest system subjected to the stresses of a fall must be taken out of service and disposed of properly.

Fall protection equipment purchased to protect workers from a fall hazard cannot be used for any other purpose. Equipment subjected to the forces of a fall arrest must be rendered inoperable and removed from service immediately or be sent to the ESH Section for use as a training aid and marked "NOT FOR FALL PROTECTION USE".

Snap hooks and carabiners shall be self-closing and self-locking and shall be capable of being opened by at least two consecutive deliberate actions.

The shock absorber end on the lanyards must be connected next to the D-ring with the other end attached to the anchorage point.

Intentionally Left Blank

Technical Appendix 4

Calculating Total Fall Distance

To avoid striking a lower surface by any part of the body, it is necessary for the user of a PFAS to understand clearly the total distance traveled from the onset of a fall to the end of the fall. To understand the calculation we will assume that the anchorage point and the D-ring of the harness are at the same level.

Total Distance traveled[1] = total length of the lanyard + total length of extended shock absorber[2] + height of the person[3] + Stretch[4] ± (diff. from anchor to D-Ring)[5]

Note 1: This is the total distance from anchorage point to the bottom of the feet at the end of a fall.

Note 2: The shock absorber may be a rip stitch type or bungee cord type. Regardless of type, any shock absorber will elongate a total of 42 inches (3½ feet). This elongation is prescribed in ANSI Standard 359.1-1992 (R1999).

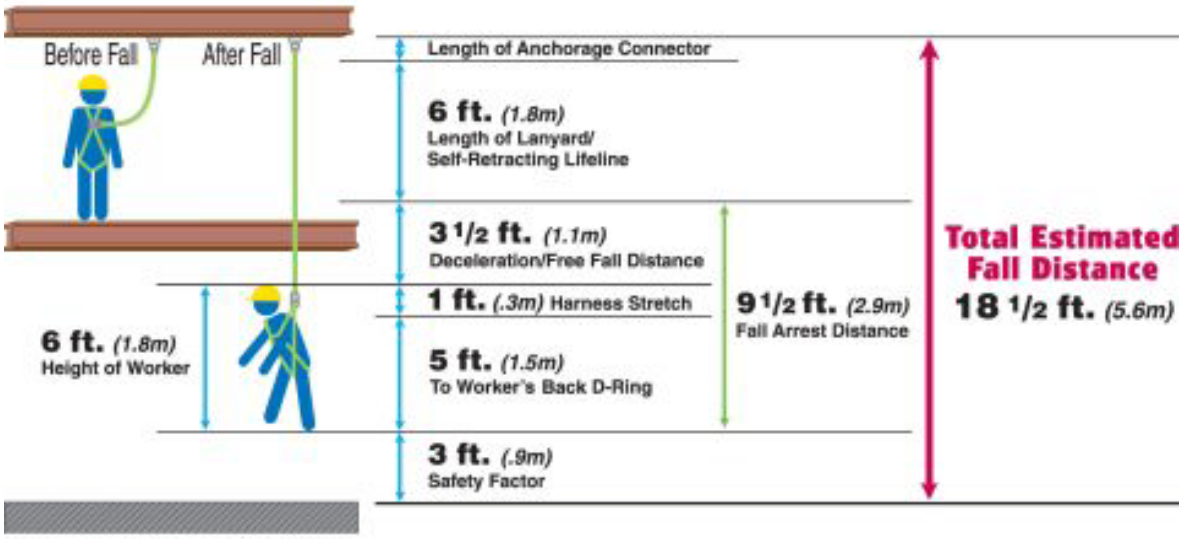
Note 3: Height is determined to nearest foot. For example, a person 5 Ft 6 in. in height would use 6 ft as his/her height. A person 5 Ft 5 inches would use 5 ft as his/her height.

Note 4: Stretch must be accounted for because all fall protection lanyards, shock absorbers and harnesses are made of synthetic fiber such as nylon or polyester. At the end of a fall these materials will stretch depending on the weight of the person. Account for a distance of 3- 5 ft of stretch based on your body weight and tools. For workers whose body weight with tools is less than 250 pounds may use 3 feet for stretch. Workers over whose body weight with tools exceed 250 pounds may use 5 feet.

Note 5: Add the difference in feet if the anchor point is below the D-Ring or substract the difference in feet if the anchor point is above the D-Ring. Using a person that is 6ft tall weighting 200 pounds and tied to an anchorage 2 feet above the D-Ring using a 6ft shock absorbing lanyard. The total distance for the fall would be,

Total Distance= 6+3½ feet+6 + 3 – 2= 16½ feet (In this example the free fall is only 4 ft)

If tied below the D-Ring by two feet then the distance is:

*Total Distance= 6+3½ feet+6 + 3 + 2= 18½ feet (In this example the free fall would be 8 ft**)*

*** A free fall of more than 6ft is strictly prohibited by the standards. In this case, all that the wearer of a personal fall arrest system can use would be a 4ft shock absorbing lanyard to be able to remain within the 6 ft rule.*