Kiewit

Fall Solutions Manual

June 2007

Kiewit

MEMORANDUM

TO: Fall Solutions Manual User

DATE: June 2007

RE: Introduction to the Fall Solutions Manual

At Kiewit our goal is to work each day without an injury. Falling has always been and will continue to be a safety issue with serious consequences. Therefore considerable efforts need to be invested in the planning and implementation of our work to assure that employees are protected from fall exposures.

This Fall Solutions Manual is a tool in the pursuit of the goal of working each day without an injury. A great deal of time and effort has been spent to provide you with the most up-to-date information regarding fall protection. These include regulations, guidelines, fall protection systems and philosophies.

Please keep in mind that this Manual is not a "catch-all." Each individual project and operation must carefully consider how to protect our employees from falling. The industry is continually providing new and improved methods for providing our workers fall protection systems. These systems need to be continually monitored and implemented when it is able to provide a more effective means of protecting our employees.

In general, the Fall Solutions Manual will provide:

- Policy and Philosophy of Kiewit's Fall Protection Program
- Fall Protection/Prevention Systems
- Post-Fall and Rescue
- Training
- Inspection procedures
- Applications

The Fall Solutions Manual was primarily developed for use by Project Managers, Superintendents, Engineers and Safety Professionals. Section C, Policy 1.0, for example lists the differences in regulations between California, Oregon and Washington. Typically a craft person will not want to know the differences. They are only concerned about how they will remain compliant while working on a Kiewit project. However, a Project Manager recently transferred between states will find the information valuable.

There is so much information available on Fall Protection that it would be easy to continually pursue the perfect option and never come to a reasonable solution. Remember at the end of the shift we want our employees to have been protected from falling. This will happen, primarily through eliminating the circumstances that would allow a fall to occur but when necessary by using fall protection systems. It is our hope that this Manual will help you in the pursuit of working today and everyday accident free.

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Section A: Policy and Program Elements

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1.0 POLICY AND PHILOSOPHY STATEMENT

It is the policy of the Kiewit Companies to perform work in the safest manner possible, consistent with good construction practices. Therefore, employees on a walking/working surface (horizontal or vertical) with an unprotected side or edge or sloped surfaces steeper than 40 degrees, which are 6 feet (1.8m) or more above a lower level will be protected from falling by the use of guardrail systems, safety net systems, or personal fall arrest systems.

The philosophy, guidelines and solutions provided in this manual should be used in developing systems and procedures to manage fall exposures. Careful analysis should be made to choose the best form of protection consistent with good work practices in every operation.

1.1 HIERARCHY OF CONTROLS

Kiewit Companies approach fall prevention and protection with these basic principles in mind:

A. The best form of fall protection is prevention – to eliminate the circumstances that could allow a fall to occur.

B. An employee will work more productively when working at grade or in areas secured by a guardrail system, than when secured by a personal fall arrest system.

C. Fall prevention and protection must take into consideration the potential for "at-risk" behavior by employees who are not proficient with the requirements for fall prevention and/or fall arrest systems. All "at-risk" employees will be provided training on the processes and systems used on each operation.

The following hierarchy of controls shall be used to develop work plans when the potential fall from a walking/working surface is 6 feet (1.8m) or more above a lower level:

A. Eliminate fall hazards (work at grade level),

B. Prevent fall hazards (engineer out the hazard),

C. Administrative controls (restraint system),

LASTLY:

D. Utilize personal fall arrest systems.

NOTE: Local or state regulations, or facility requirements may be different than above. The most stringent requirement shall apply.

1.2 PROTECTION FROM FALLING OBJECTS

A. When jobsite personnel are exposed to falling objects, employees shall wear hard hats in compliance with the following:

1. Hard hats (worn bill forward only) are required by all employees, visitors, and/or vendors when inside our work area. Bump caps do not provide adequate head protection and will not be permitted on our job sites.

2. Metal hard hats do not provide adequate protection from electrical hazards and will not be permitted on any job site.

3. Stetson (cowboy) style hard hats do not meet minimum standards and will not be permitted on any jobsite.

B. Additionally:

1. Guardrail systems shall be installed with adequate toeboards or screens, high enough to prevent materials from falling from higher levels; or,

2. Erect a canopy structure and keep potential fall objects far enough from the edge of the higher level so that those objects would not go over the edge if they were accidentally displaced; or,

3. Barricade the area to which objects could fall, prohibit employees from entering the barricaded area, and keep objects that may fall far enough away from the edge of a higher level so that those objects would not go over the edge if they were accidentally displaced.

2.0 FALL PROTECTION BASICS

This section provides the basics for understanding the different types of fall protection systems, components, applications and inspections of those systems.

2.1 TYPES OF CONTROLS

Passive – a fixed system that provides protection against falls. It is the most preferred type of control. Guardrail systems are a primary example.

Active – a connection to the body (except nets) and a fall to a lower level occurs before arrest, incurring dynamic forces. Active is a system used by an individual to restrain and restrict, or arrest a fall. Personal fall arrest systems are a primary example.

2.2 ACTIVE SYSTEMS

A **Personal Fall Arrest System (PFAS)** is an assembly of components and subsystems, including the necessary connectors, used to arrest the user in a fall from a working height and suspend the user until rescue can be affected. A personal fall arrest system must always include a full body harness and connecting means between the harness and an anchorage or anchorage connector. Such connecting means may consist of a lanyard, energy (shock) absorber, fall arrester (rope grab), lifeline, self-retracting lanyard or qualified combinations of these. Systems that include a series of tie-backs, triangulating the load will require engineered methodology and cannot automatically be considered a PFAS.

The **Suspension** configuration permits workers to sit and work safely while elevated. Unlike the fall arrest configuration, the suspension configuration distributes the worker's weight on areas of the body capable of bearing that weight for extended periods. A suspension system is designed to raise or lower and support a worker at an elevated work station. The connecting points of the system, such as shoulder or seat-strap D-rings, are NOT designed to properly distribute the impact forces that result in arresting a free fall. A suspension system alone cannot be relied upon to provide proper fall arrest protection. The worker must be properly attached to an independent fall arrest system if a free fall is possible.

A **Restraint System** is an assembly of components and subsystems, including the necessary connectors, used to restrict the user's motion so as to prevent reaching a location where a fall hazard exists.

A **Positioning System** includes the user's harness and connecting means between the harness and an anchorage or anchorage connector. Such connecting means usually consist of a positioning lanyard which is connected to both hip D-rings of the harness and wraps around, or connects to, an anchorage or anchorage connector. A positioning system must always be backed up by a personal fall arrest system. A travel restriction system consists of the user's harness and a fixed length or adjustable length lanyard connected between any one of the harness D-rings and an anchorage or anchorage connector.

A **Retrieval System** provides a quick means of lifting or pulling the user out of a working environment. The system supports full body weight for a short period of time, but should not be used for suspension. Vertical retrieval systems, which may incorporate a harness having two shoulder D-rings, are used frequently in confined spaces such as storage tanks or manholes which may pose potentially dangerous conditions. A retrieval system by itself, however, may not provide all the protection a worker requires.

2.3 COMPONENTS

Anchorage
Anchorages come in many shapes, sizes and forms. An anchorage is a secure point of attachment for lifelines, lanyards or deceleration devices. **Anchorages** shall be capable of supporting at least 5,000 lbs. per user attached, or shall be designed, installed and used under the supervision of a Qualified Person as part of a complete system which maintains a safety factor of at least two. **Anchorages** for a Self Retracting Lifeline (SRL) shall withstand a tensile load of 3,000 lbs statically applied directly to the point of SRL line connection to the SRL drum.

Body Harness
A full body harness is a design of straps which contains the torso and is secured about the user in a manner to distribute the arresting forces over the torso and thighs with a means for attaching other components of a personal fall arrest system. Attachments for restraint, retrieval, or positioning may be included.

Connectors
Connectors come in many shapes, sizes and forms. A connector is a component or element used to join together parts of a system or components within a system. They serve a variety of purposes and may be a separate and distinct component such as a carabineer, or an integral part of a component such as a snaphook spliced into a lanyard. The term integral means not removable without mutilating any part of the component or without the use of special tools.

Examples: Snaphooks, carabineers, D-rings, buckles, grommets, strap collars, adjusters, O-rings.

Deceleration Device
A deceleration device is any mechanism which serves to dissipate energy during a fall. Examples of deceleration devices are: rip-stitch, friction, rope-grab, tearing and deforming lanyards.

2.4 APPLICATIONS

Before any fall protection systems can be utilized, a qualified person must inspect the workplace and determine if identified hazards can either be eliminated or prevented.

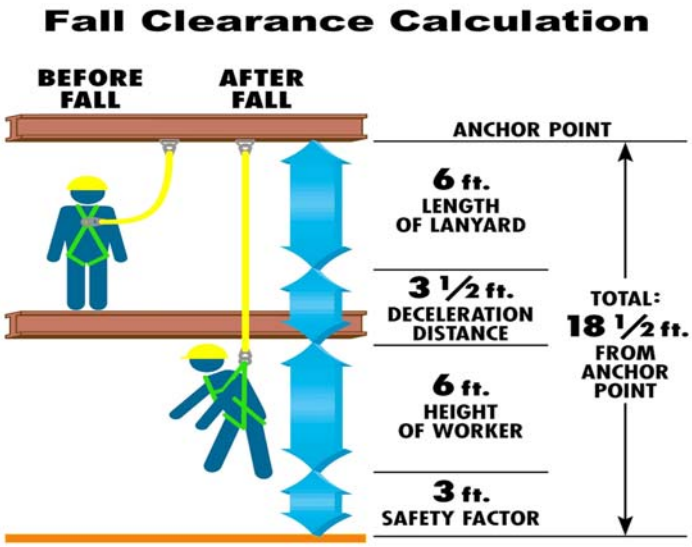
Prior to selecting the fall prevention systems to be utilized, a workplace assessment of the hazards and conditions where the equipment is required must be completed. This assessment must, at a minimum, identify the presence of:

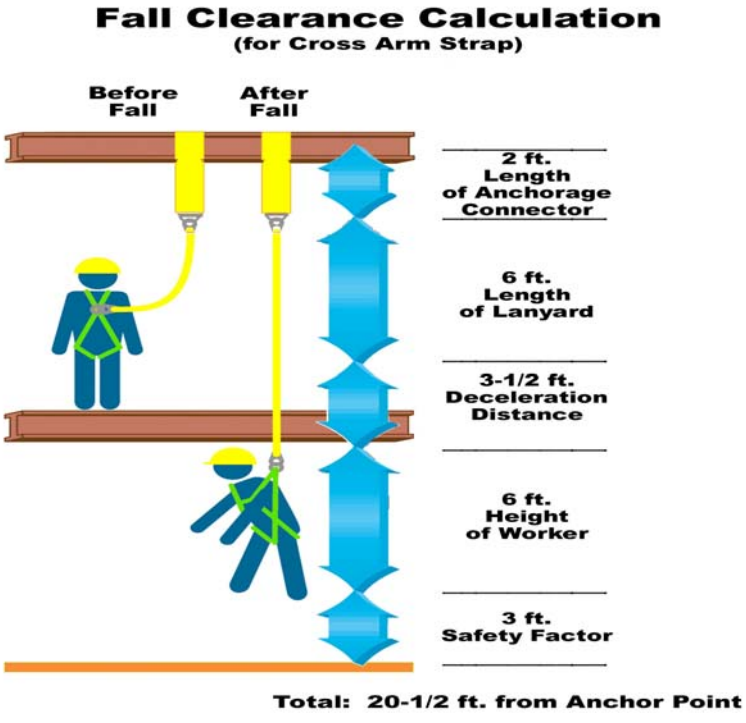
Abrasive Surfaces	Heat Producing Operations	Unguarded Openings
Chemicals	Impalement Hazards	Unstable Surfaces
Climatic Factors	Moving Equipment	Weather Factors
Confined Space Hazards	Moving Materials	Or Any Other Identified Hazard
Electrical Hazards	Sharp Objects	
Environmental Contaminants	Slippery Surfaces	
Flames and Sparks	Uneven Surfaces	

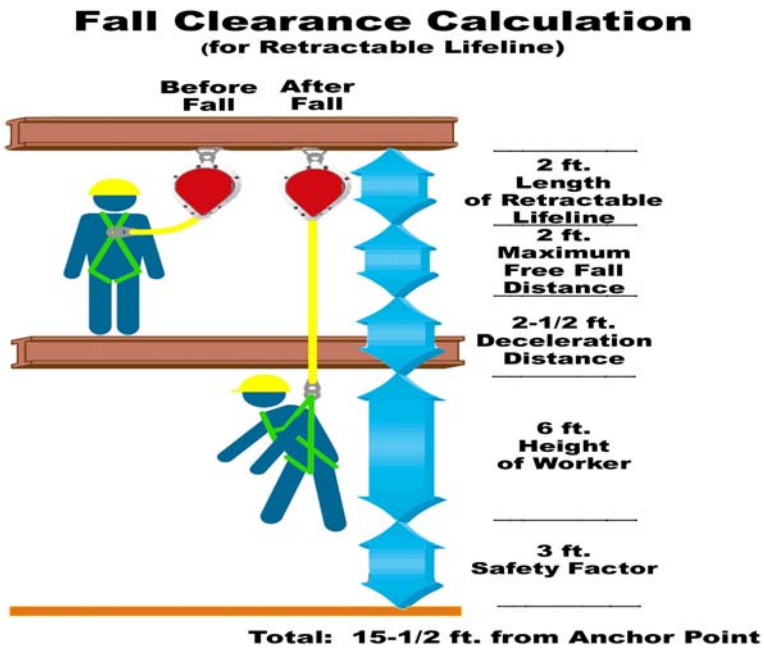
Foreseeable changes in any of these conditions, taken individually or collectively, must be identified, evaluated and controlled. The materials and construction of the harnesses and associated equipment must be considered in the selection process, such that these workplace conditions are adequately addressed.

The workplace assessment must identify all paths of intended user movement and all hazards along such paths. The qualified person must identify the required range of mobility in each hazard zone and note the location and distance to all obstructions in potential fall paths. Lateral obstructions which could be contacted in pendulum-type fall arrest must be noted. An assembly connecting the harness to an anchorage must be selected that will satisfactorily limit total fall distance and allow for dynamic elongation and activation distance of the assembly.

Fall clearance should be properly calculated to prevent injury to the user. The following considerations should be applied when calculating fall clearance:







Evaluation of the personnel assigned to use any fall arrest system must be performed to ensure proper sizing of components to the user. A sizing chart is contained in the user instructions and manufacturer's catalog, for the components (full body harnesses specifically) they design.

If a system is to be used for confined space entry operations, the workplace assessment must comply with the requirements of the regulations governing confined space entry.

When fall arrest components made by different manufacturers are used in a system, a Competent Person shall determine that they meet the requirements of established standards and are compatible. Written manufacturer's approval may be required. Consult the District Safety Manager.

NOTE: Most fall protection equipment manufacturers specifically state not to mix components of their brands with that of other manufacturers. This is important because of the design ratings of the components available.

2.5 INSPECTION

Even though a maximum life of fall arrest equipment may be established by standards and/or manufacturers, this does not mean it will last for that defined period. Therefore, inspection of a Personal Fall Arrest System shall be conducted prior, during, and after each use by trained employee(s). The superintendent is responsible to ensure this is effectively managed on his/her operations.

The owner's manual provided by the manufacturer with each fall arrest component or system details the inspection, maintenance and use criteria. The manufacturer's instructions (for each component) shall be provided to an employee. The superintendent is responsible to ensure the employee reads and understands the requirements for safe use of each component. The owner's manual shall be retained on site and be readily available for all components used at that project.

Pre-Issuance inspections should be completed by a Competent or Qualified Person prior to the initial use of any fall arrest system or component. Brand new equipment can be defective, thus inspection prior to initial use is required. **(The date of first use shall be legibly recorded on the inspection tag**

or label, or on an Inspection Log using component serial numbers). An example Log can be found in Section A, Policy 7.1.

Daily inspections shall be completed by the user. Prior to each use, during and after each use fall protection equipment shall be inspected by the user for defects, damage or deterioration. Any defective equipment shall be removed from service and turned into supervision. The user should be instructed to observe equipment for the appearance of specific defects which could affect reliability and their personal safety.

Formal inspections shall be made by either a Competent or Qualified Person on a quarterly basis.

NOTE: If the manufacturer's label is not legible or is missing, the equipment shall be removed from service. Maximum field life of soft goods is five years. All equipment five years or more shall be removed from service and destroyed.

Do not write or paint on any part of personal fall protection equipment.

2.6 FALL PROTECTION PLANS

A Fall Protection Plan should be developed for all operation(s)/task(s) where fall exposures exist, even when protected with a guardrail system. The only time a Fall Protection Plan is not needed is when the fall exposure is completely eliminated.

2.6.1 A Fall Protection Plan, (Section A, Policy 5.1) shall be written when a free fall of greater than six feet is possible or when other hazardous conditions exist. A qualified person must write the plan and explain, in detail, the prevention and protection system to be employed in the operation; in conformance with the following provisions:

(1) A copy of the Fall Protection Plan with all approved changes shall be maintained at the work location. A copy may also be sent to the District Safety Manager.

(2) A copy of the Fall Protection Program Self-Assessment Checklist located in Section A, Policy 7.2 should be used for fall protection hazard assessment.

(3) The implementation of the Fall Protection Plan shall be under the supervision of a competent person. (Competent person shall be specifically named in the Plan.)

(4) The Fall Protection/Prevention Plan shall document the reasons why the use of conventional fall protection or prevention systems (scaffolding, guardrail systems, personal fall arrest systems, or safety net systems) are infeasible, or why their use would create a greater hazard.

(5) The Fall Protection Plan shall include a written discussion of the measures that will be taken to reduce or eliminate the fall hazard for workers who cannot be provided with protection from conventional fall protection systems.

(6) The Fall Protection Plan must include a statement that provides the name(s), or other method(s) of identification, for each employee who is designated to work in the area. Non-trained and non-designated employees may not work in these areas.

The Fall Protection Plan shall contain at a minimum:

- Location
- Task description
- Fall hazards
- Methods of protection
- Equipment required
- Equipment utilization
- Work area controls
- Rescue Plan
- Sketches

Fall Protection plans require written approval by the Job Sponsor or other manager as designated by the District Manager.

2.6.2 The Fall Protection/Prevention Work Plan, (Section A, Policy 5.2) may be used when conventional fall protection or prevention methods will assure a free fall of six feet or less. The Fall Protection/Prevention Work Plan must be attached and made a part of the hazard analysis for the work activity.

If an employee falls, or there is some other related serious incident or exposure, the plan shall be reviewed to determine if additional practices, procedures, or training need to be implemented to prevent similar types of exposures, falls or incidents. This information shall be immediately communicated and documented to all affected employees. The amount of time required for this step will vary depending on the type of work and the system requirements. It is important to assure an employee is proficient with the requirements of the system.

All fall related incidents, regardless of their nature, shall be investigated and reported. It is an integral part of any safety program that documentation takes place as soon as possible so that the cause and means of prevention can be identified to prevent a similar incident.

2.7 TRAINING

Training for each employee who might be exposed to fall hazards shall be conducted and documented prior to the use of any system or component. The program shall enable the Authorized Person (user with basic knowledge of fall protection systems and how to inspect and use systems) to recognize the hazards of falling and shall train the Authorized Person(s) in the procedures to be followed in order to minimize these hazards.

Authorized Person is to be trained in the following areas by a competent or qualified person, as applicable, to the protective system(s) to be utilized:

- The nature of fall hazards in the work area;
- The correct procedures for erecting, maintaining, disassembling, and inspecting the fall protection systems to be used;
- The use and operation of guardrail systems, personal fall arrest systems, safety net systems, warning line systems, and other protection to be used;
- The limitations on the use of mechanical equipment during the performance of roofing work on low-sloped roofs;
- The correct procedures for the handling and storage of equipment and materials and the erection of overhead protection; and
- The role of employees in fall protection plans.

Certification of training shall verify compliance by preparing a written certification record. The job specific written certification record shall contain the name of the trainer(s) with support details, identity of the Authorized Person trained, the date(s) of the training, and the signature of the person who conducted the training. All documentation for design, inspection, and training sessions shall be kept on file at the job site.

Training is an effective way to continually remind employees of the hazards and will lead to creative ways to eliminate possible hazards. Training shall be done for each fall exposure to ensure buy-in and compliance.

Retraining will be conducted when there is reason to believe an affected Authorized Person who has already been trained does not have the understanding and skill required. It is recommended that re-training be provided to all Authorized Persons anytime there is a change in the work plan and at least on a bi-annual basis, regardless of proficiency.

Circumstances where retraining is required include, but are not limited to:

- Changes in the workplace render previous training obsolete; or
- Changes in the types of fall protection systems or equipment to be used render previous training obsolete; or
- Inadequacies in an affected employee's knowledge or use of fall protection systems or equipment indicate that the employee has not retained the requisite understanding or skill.

A syllabus for training is contained in this manual (Section A, Policy 6.0).

3.0 FALL PROTECTION/PREVENTION SYSTEMS

3.1 GUARDRAIL SYSTEMS

There are many types of guardrail systems that can be used for protection against falls. The Kiewit Companies has identified standard systems which should be used on our projects unless infeasible, or when in direct conflict with local regulatory agencies or facility standards.

These standard systems comply with recognized regulatory standards. It is important to note that individual locations may have variations to the requirements established in this guide, so each project must have a qualified person review all local standards to ensure conformance.

Minimum specifications for guardrails are as follows:

TYPE OF MATERIAL	SIZE OF TOP/MID RAIL [IN]	HEIGHT [IN] TOP RAIL	POST SIZE/ SPACING	STRENGTH [LBS.]
WOOD	2x4/1x6	42	2”x4”/8’	200
PIPE	1½ nominal OD	42	1½ nominal/8’	200
STEEL	2”x2”x3/8” angle/8’	42	2”x2”x3/8” angle/8’	200 or equiv. Bend. Strength
WIRE ROPE	3/8”	42	Equivalent to one of above	200

The top rail shall be installed between 42” and 45” from the walking/working surface. Mid rail height will be approximately one half of the distance from the top rail and the floor or ground. A second mid-rail may be required when the height of a handrail was installed to accommodate a temporary walking/working surface and not the completed finished deck surface.

The top rail has a maximum allowed deflection in any one direction when a 200 lb. force is applied in an outward and downward direction. Minimum deflection is not defined for wood; however, when using wire rope the maximum mid-span deflection must be not more than three inches. Additionally, all wire rope rails must be flagged with a highly visible material at least six feet on center.

Post and post anchorages must also be able to withstand a 200 lb. force outward and downward at any point on the post or railing and posts must not be spaced more than 8’ apart from each other.

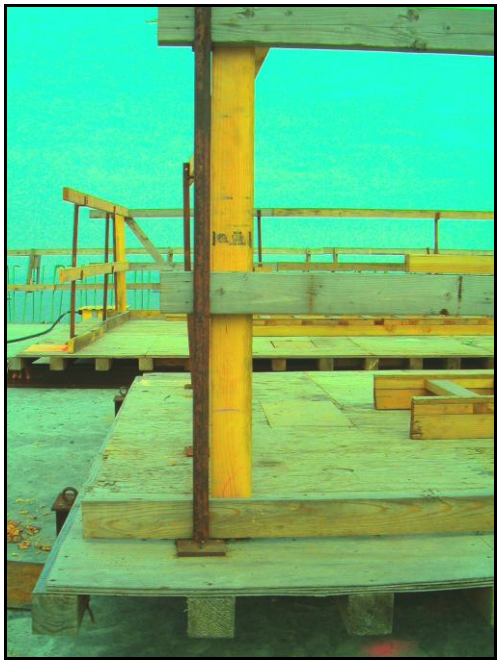
Toeboard for all system types must be a solid material with a minimum nominal height of 4 inches. Not more than a ¼-inch gap shall be allowed between the floor and bottom of the toeboard, with 1-inch maximum gaps. Toeboard height may need to be greater than 4 inches if materials stored or stacked next to toeboard is greater. In all cases, as a minimum, toeboards shall be 4 inches above the floor or the top of stacked materials, whichever is greater.

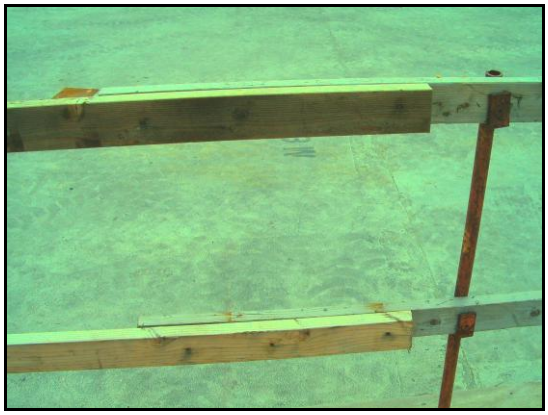
When guardrail systems are used over heavily traveled areas or public roadways, a full height barrier will be installed to prevent debris from falling through the guardrail. Common materials used in this application have included plywood, screening, or plastic mesh fencing (with ¼” openings).

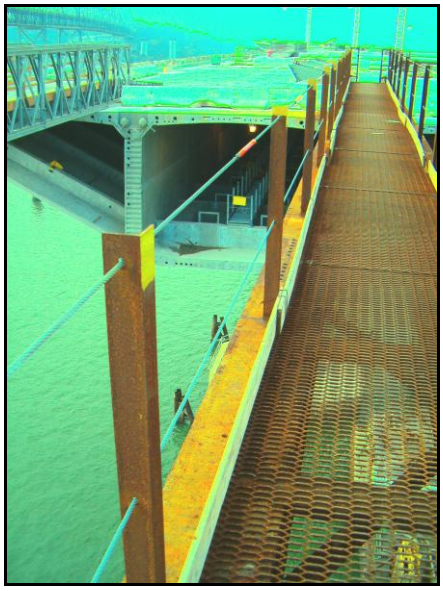
When using these materials, particularly plywood, extra precaution should be taken to ensure it is adequately secured to the guardrail so it cannot be stripped by high winds. The guardrail system must be evaluated to ensure the additional loads can be sustained.

NOTE: The height of installed handrail should be based on the finished deck surface and not the temporary working/walking surface. Installation of additional members at the time of construction may be required.

COMMON EXAMPLES OF GUARDRAIL CONSTRUCTION

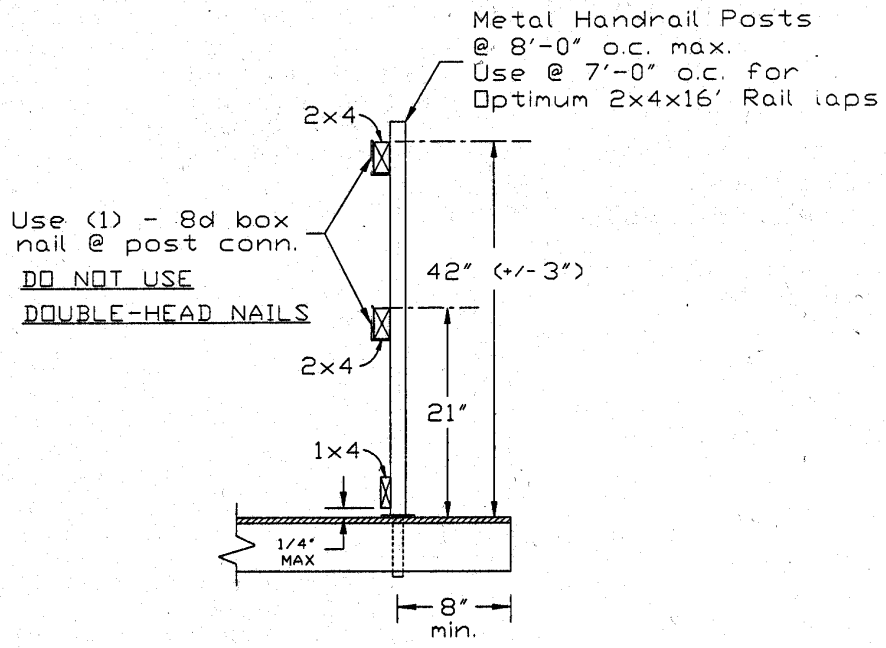






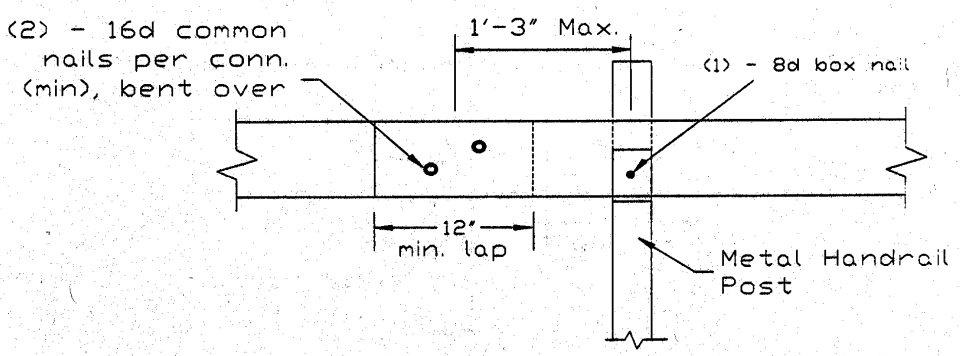
HANDRAIL DETAILS

(For Metal Handrail Posts)

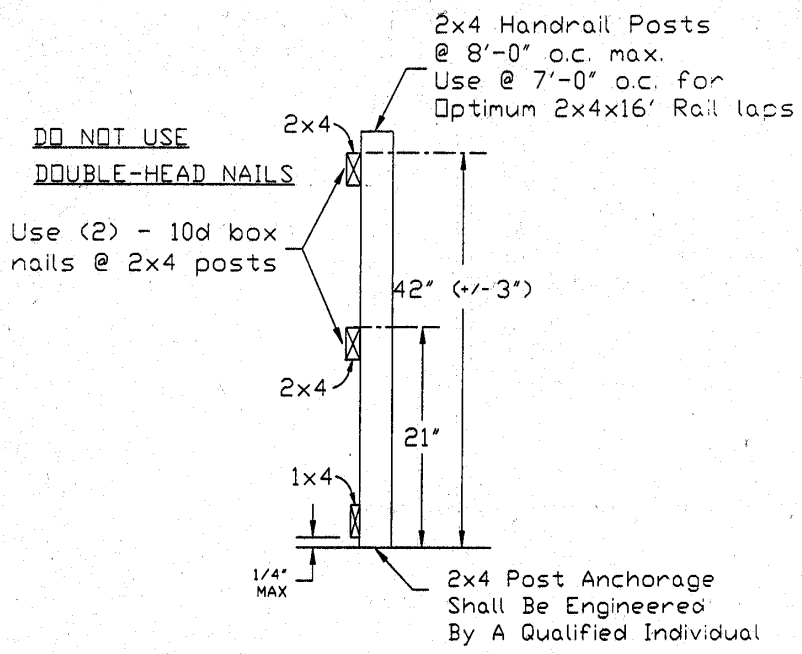


SPLICE CONN. DETAILS

Note: Center of splice should be no more than 1'-3" away from post.

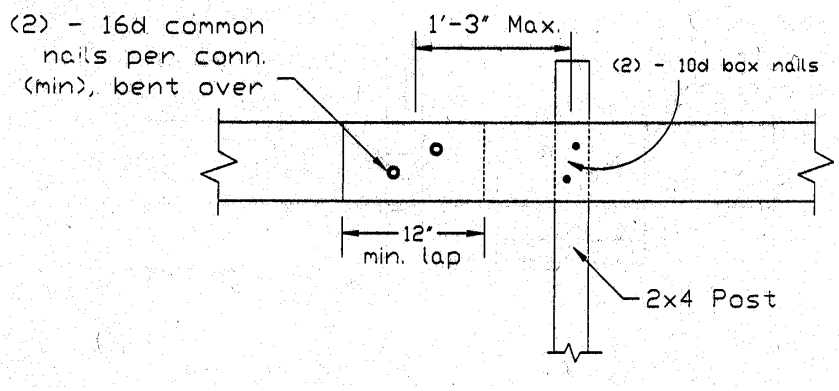


HANDRAIL DETAILS
(For 2x4 Posts)



SPLICE CONN. DETAILS

Note: Center of splice should be no more than 1'-3" away from post.



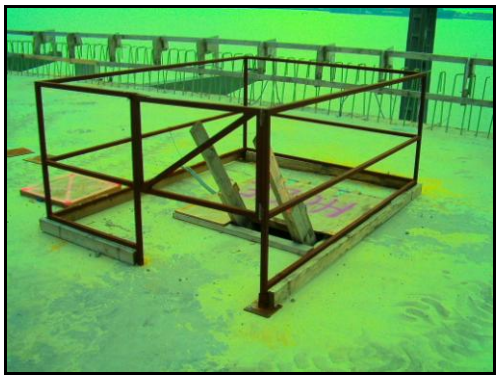
3.2 MANUFACTURED/PRE-MADE GUARDRAIL SYSTEMS AND COMPONENTS

There are many manufacturers of guardrail systems and components. If these systems are utilized, ensure the manufacturer data is readily available and their use instructions are being followed.

Examples of such systems and components:

Railguard 200
Garlock Equipment
www.railguard.net
(800) 328-9522

Verishield Guardrail Clamping System
www.safetyboot.com/versishield.html
(800) 804-4741



Job Built per Engineer Design
Self Closing Gate Required

Safety Boot
www.safetyboot.com
(800) 804-4741

3.3 RESTRAINT SYSTEMS

Restraint systems (often referred to as "dog leash") eliminate the risk of a fall by physically restraining an employee from reaching the unprotected edge or side. These systems are typically installed from a fixed anchorage or from between two anchorages to which a worker is secured in order to prevent the worker from walking or falling off a surface to a lower level. A restraint system is not a fall arrest system and is not designed for leaning.

Restraint systems are particularly difficult to design because of workplace geometry and human factors. If the restraint system is too short, the worker will detach near the edge; if too long, long free falls can be expected; and if leaning occurs near an edge, a back up (fall arrest) system is required.

When using restraint systems, swing falls are one of the greatest risks. The risk of a swing fall is increased when an employee moves away from the anchorage point, such as when on the roof of a building or on a bridge deck. In a fall, the employee will swing back under the anchorage during a fall.

A swing fall increases the risk of striking an object or lower level during the pendulum motion. It is important to consider the following when planning to use a restraint system:

- Fall distance can actually increase during a swing fall.
- The shock load from a swing fall can be the same as it would be for a vertical fall with the same change of elevation.
- During a swing fall an employee can strike an object or lower level before the arrest system stops the fall.

Restraint lines and their anchorages shall be designed with the same force capacity as horizontal lifelines.

NOTE: Two documents located in Section C, Policy 7.0, (1) Bacou-Dalloz (Miller) Fall Protection, Technical Brief 102 and (2) a June 20, 2006 letter from Tom Skoro, Pacific Structures District Manager describe the concerns of using self-retracting lifelines (SRLs) horizontally. For this reason, all horizontal use of SRL's require the installation of an external deceleration device, such as the Miller SofStop or other component approved and compatible with system.

3.4 WARNING LINES

Warning lines can only be used when conventional and/or temporary guardrail systems are infeasible as determined by a competent person. Conventional and/or temporary guardrail systems provide better protection and security for employees exposed to a fall. Warning line systems may only be used as a last resort during roof work on low-pitched roofs or during leading edge activities.

To use the warning line system as a fall protection method for low-pitched roof work or leading edge work it must meet all of the criteria for a warning line as outlined below:

1. The warning line is erected at least 6 feet from the unprotected edge.
2. The warning line is between 34 and 39 inches tall, and flagged with highly visible material every 6 feet or less. The line may be rope, wire or chain and must have a minimum tensile strength of 500 pounds. It must be attached to each supporting stanchion so that pulling on the line on one section between stanchions will not result in slack being taken up in an adjacent

section before the stanchions tip over. The stanchions supporting the line must be capable of supporting a 16-pound horizontal load when applied 30 inches from the working surface.

3. Employees have been trained in the use of the warning line, its limitations and the requirement for additional fall protection when working outside of the warning line.

3.5 SAFETY MONITOR SYSTEMS ***(Safety Monitoring Systems are not allowed on Kiewit Projects)***

A safety monitoring system means a fall protection system in which a competent person is responsible for recognizing and warning employees of fall hazards. The duties of the safety monitor are to:

1. Warn by voice when approaching the open edge in an unsafe manner.

2. Warn by voice if there is dangerous situation developing which cannot be seen by another person involved with product placement.

3. Be competent in recognizing fall hazards.

4. Warn employees they are unaware of a fall hazard or working in an unsafe manner.

5. Be on the same walking/working surface as the monitored employees and within visual sighting distance.

6. Not allow other responsibilities to encumber monitoring.

If the safety monitor becomes too encumbered with other responsibilities, the monitor shall (1) stop work; and (2) turn over other responsibilities; or (3) turn over the safety monitoring function to another designated, competent person.

3.6 HORIZONTAL LIFELINES

A. Definition: A horizontal lifeline is an ***engineered*** rail, rope, wire or synthetic cable system installed horizontally and used for attachment of other components of a personal fall arrest system (e.g. lanyard or lifeline device) while moving horizontally.

Note: ***Horizontal installation requires the lifeline to be connected between two fixed anchorage points on the same level. The ANCHORAGE POINT (Lifeline) needs to be at waist level minimum.***

The purpose of a horizontal lifeline is to limit the possibility of a pendulum swing injuries by continuously providing an elevated anchorage point as the worker moves horizontally during access or work tasks. This allows the fall arrest to occur within a vertical plane.

(Swing falls can generate the same forces as falling an equal distance vertically, but present the additional hazard of striking an object.)

B. Application Considerations:

1.) All horizontal lifelines must be designed and stamped by a Registered Professional Engineer.

Note: ***Need to specifically call out all components with load capacity. This includes and is not limited to manufacturers, part numbers, load rating and where they will be located in the system. Additionally, need to include an illustration of the system including the worst case scenario of a fall event.***

2.) *Selection and Use*: Horizontal lifeline components shall be protected against being cut or abraded. Additionally, when subject to damage from operations such as welding or sandblasting, horizontal lifelines should be protected. Seasonal weather and other environmental conditions should also be considered. **Wire rope shall not be used where an electrical hazard is anticipated.**

3.) *Component Compatibility*: Since some components of the system wear out before others, it is common practice to replace components as needed. Not all components are interchangeable. Any substitution or change to a personal fall arrest system should be fully evaluated by a Qualified person to ensure established requirements are met.

4.) *Elongation and Deceleration Distance*: During fall arrest, a lanyard will experience stretching or elongation. Additionally, the activation of a deceleration device will result in a certain stopping distance. These distances must be added to the free fall distance to arrive at the total distance a person will fall prior to stopping. Sufficient distance to allow for each of these factors must be maintained to prevent injury from impacts to objects below.

5.) *Obstructions*: The location of the horizontal lifeline should also consider the hazard of obstructions below that may potentially be in the path of a fall. Systems should be designed in such a way the user cannot come in contact with any obstruction or lower level.

6.) *Free Fall*: To limit the maximum arresting force, free fall distance should be kept to a minimum. **The maximum allowed free fall distance is 6 feet.** To help assure this, the tie-off attachment point (the horizontal lifeline) should be located at or above the connection point of the fall arrest equipment (the back "D" ring on the body harness). Use of manufactured stanchions that make the anchorage attachment at waist level should only be used with a shorter Shock Absorbing Lanyard or an approved Self Retracting Lifeline in order to limit free fall distance.

7.) Horizontal lifelines at 36" or less from the working surface ("foot-level" lifelines) are **only** permitted when approved by the Job Sponsor and all of the conditions outlined in the regulatory requirements have been met. An in-line deceleration device is required in this configuration.

8.) *Rescue*: Refer to Section A, Policy 4.0, Post-Fall and Rescue.

C. Requirements:

1.) Design:

i. All horizontal lifelines must be designed by a Registered Professional Engineer, usually a Structural Engineer.

Note: ***Need to specifically call out specifications of all equipment by brand, part number, load rating and location in the system. Need to specify the number of users that are allowed to be on the system at one time and the specific type of equipment to be used.***

ii. The maximum arrest force a worker may be subjected to during a fall arrest event is 900 pounds. However, in most cases the Maximum Arresting Force will be defined since the lanyard itself will contain an in-line shock absorber that limits the force applied to the lanyard. (Generally, this force will range between 650 and 900 pounds depending on the type of equipment used.) Potential arresting force from a free fall should also include distance of free fall and mass of the employee.

iii. Self retracting lifelines, lanyards, D-rings, snap-hooks, and carabineers shall be capable of sustaining a minimum tensile load of 5,000 pounds applied with the lifeline or lanyard in the fully extended position.

iv. Anchorages used for attachment of personal fall arrest equipment shall be independent anchorages capable of supporting at least 5,000 pounds per employee attached, or shall be designed, installed, and used as follows:

a. As part of a complete personal fall arrest system which maintains a safety factor of at least two; and

b. Under the supervision of a *Qualified Person*.

c. The standard criteria and protocols apply to persons with a combined body and tool weight of 310 pounds or less. An engineering analysis is required for persons with a combined body and tool weight in excess of 310 pounds.

2.) Instructions for Use:

Prior to purchasing, using a manufactured system or a system designed by the company or an engineer, the following information should be obtained from the supplier: test data (such as: force measurements, elongation measurements, deceleration distance, etc.), comprehensive instructions for use and installation, application limits, and, inspection and maintenance requirements as well as details of connection components, e.g. bolts, pins, shackles.

Note: ***All users of Horizontal lifelines (Authorized, Competent, or Qualified Persons), shall inspect systems before, during, and after each use.***

3.) Anchorage Points:

The attachment points for horizontal lifelines must be carefully planned to ensure continuous and complete protection during the performance of the work. This includes travel to and from the work station. All anchorage points must be designed under the supervision of a Qualified Person as defined in this policy; however, anchorage points for a horizontal lifeline must be designed by a Registered Professional Engineer.

Horizontal lifelines shall <u>not</u> pass over or around rough or sharp edges (such as the edge of an I-beam, or torch hole in a plate). The use of thimbles or softeners is required in these applications.

Extreme care should be taken when considering horizontal lifelines for multiple tie-offs. The number of employees using a horizontal lifeline at the same time should be limited to 2 people.

4.) Self-Retracting Equipment:

When self-retracting lanyards are connected to a horizontal lifeline the sag in the lifeline should be minimized, and only allowed by the design to prevent the device from sliding down the lifeline and creating a swing hazard during fall arrest. Self retracting lifelines should not be used at waist level unless specifically designed for that purpose. When using self-retracting equipment on Horizontal Lifelines the Manufactures Equipment needs to be identified.

5.) Inspection (applies to both Manufactured and Job-Built Horizontal Lifeline Systems):

i. The date of the first use shall be recorded.

ii. Employees need to be trained and given the authority via training on what to look for during inspection of Horizontal Lifelines.

iii. Manufactured horizontal lifeline systems: inspection and maintenance shall be performed in accordance with the manufacturer's instructions and/or by the user's organization. Such criteria shall equal or exceed the greater of the criteria established by the ANSI Z359.1-1992(R1999) or the manufacture's instructions.

Note: The manufacturer's instructions shall be readily available for reference.

iv. Manufactured and Job-built horizontal lifeline systems: Formal documented inspections shall be made by a *Competent* or *Qualified Person* at least quarterly and/or each time the system is removed, reinstalled or reconfigured. All components of the system must be thoroughly inspected.

v. The user shall inspect before, during and after the fall protection equipment (including anchorages, connections, lifelines, deceleration devices, lanyards, harnesses, etc.) is used. Equipment with evidence of defects, damage to, deterioration, or inadequate maintenance of equipment shall be removed from service and repaired or destroyed as appropriate. These components should have a maximum use life of 5 years.

The following defects or damage to components shall be cause for removal from service:

a. Absence or illegibility of markings
b. Absence of any elements affecting the equipment form, fit, or function
c. Cracks, cuts, tears, abrasions
d. Stretching
e. Alterations
f. Corrosion
g. Distorted or faulty hardware
h. Excessive wear

vi. If the manufacturers label is not legible or is missing, the equipment (or component) shall be removed from service.

vii. **If a fall occurs**, the system and all of the components (including personal fall arrest equipment worn by the employee) shall be taken out of service. The components should be sent to the District Safety Manager.

6.) Documentation:

The following information regarding the design, testing, and inspection of horizontal lifelines should be documented and filed on the job site.

i. Design:

a. Manufactured Systems:

i. Applications limits.
ii. Instructions for installation and use.

b. Job-built Systems:

i. Designed by a Registered Professional Engineer.
ii. Design parameters (application limitations).
iii. Design calculations and drawings (as applicable).
iv. Specific installation procedures (as applicable).

c. Details which should be included in design:

i. Call out details from the wire rope to all connecting members.
ii. Diagram of fall clearance.
iii. Inspection documentation and recommendations.
iv. The weakest rated component to ensure system will perform as specified.
v. Documentation of inspections.

ii. Inspection:

a. Record the date of first use on an inspection tag and attach to the system.

b. Manufactured Systems: Document formal inspections performed as required by the manufacturer.

c. Job-built Systems: Document formal inspections made by *Competent* or *Qualified Persons*. (This is required semi-annually and each time the system is removed, reinstalled or reconfigured.)

7.) Employee Training:

All employees shall be trained on the systems and components for which they will be required to use.

3.7 VERTICAL LIFELINES

The following sequence of alternatives should be used when planning fall prevention and protection for vertical applications, in descending order of desirability.

A. Eliminate the circumstances that expose the employee to a fall.

B. Perform the work at grade, preventing the need for fall protection.

C. Wherever feasible, utilize access to the work that does not require the use of fall protection equipment such as stairways, stair towers, inclined ladders up to 30 feet in height, or vertical ladders up to 20 feet in height.

D. When other means of access are not practical, a vertical lifeline with a Ladder Climbing Safety Device (LCSD), or a self-retracting lanyard will be used while climbing (see below).

USE OF A LCSD

Subject to the provisions of ANSI 14.3, which states that when a LCSD is used:

(1) Manufacturer's specifications are to be met when using LCSD.

(2) The LCSD must move freely upward and downward; locking only in the event of a fall or sudden acceleration. This allows the device to function with the employee's hands free.

(3) If the LCSD device has to be manually released and moved during the climb, it detracts from the user's ability to grasp the ladder/form and is not acceptable.

(4) The user must attach the LCSD to the chest D-ring. The distance between the D-ring chest attachment and vertical lifeline shall be 9 inches or less.

(5) It permits only one (1) person to be attached to the lifeline at a time.

(6) The design of the vertical cable shall be such that the assumed arresting force is twice the allowable full-body harness arresting force of 1,800 pounds. Therefore, the ultimate strength of the cable and the cable attachment point must be a minimum of 3,600 pounds.

(7) It is typical to have an in-line deceleration device installed at the top of a vertical lifeline. Refer to specific manufacturer's requirements or the system design requirements.

E. Use of self retracting lifelines:

(1) May need to be equipped with a Miller SofStop (see Section C, Policy 7.0).

(2) Requires swing hazards be evaluated for each application and users be trained and cognizant of the swing potential.

(3) As a restraining device must not allow the employee to reach the leading edge when fully deployed (unless permitted by manufacturer).

(4) Shall **limit** free fall distance to two (2) feet or less, and be capable of sustaining a minimum tensile load of 5,000 pounds.

F. If a LCSD is not yet in place, or is not practical, and use of a retractable lifeline is not possible, then a system where two lanyards used alternatively to positively connect to a suitable anchorage point will be used. OSHA stipulates the following anchorage point requirements:

(1) OSHA 29 CFR 1926.502(d)(15) states that:

"Anchorages used for attachment of personal fall arrest equipment shall be independent of any anchorage being used to support or suspend platforms and capable of supporting at least 5,000 pounds per employee attached, or shall be designed, installed, and used as follows: (i) As part of a complete personal fall arrest system which maintains a safety factor of at least two; and, (ii) Under the supervision of a qualified person."

(2) OSHA further elaborates on anchorage points in 29 CFR 1926.503 Appendix C, Paragraph II (h)(1)(ii) and states that:

". . . Examples of what might be appropriate anchorage points are steel members or I-beams if an acceptable strap is available for the connection . . . ; large eye-bolts made of an appropriate grade steel . . . ; or, masonry or wood members only if the attachment point is substantial and precautions have been taken to assure that bolts or other connectors will not pull through. A qualified person shall be used to evaluate the suitability of these 'make shift' anchorage points with a focus on proper strength."

(a) When utilizing anchorage points as a means of fall prevention and protection, and climbing or moving vertically to access a work area (more than 6 feet to a lower level), a system of two (2) lanyards (double lanyard) or "Y" lanyards will be used. One lanyard is secured to an anchorage point before the other lanyard is disconnected. The use of two lanyards simultaneously, is referred to as being 100% tied off and employees must be trained in this tie off procedure. The lanyard hooks must be completely closed and secured preventing accidental disengagement.

(b) When employees reach the location where work will be performed, both a primary lanyard and secondary (positioning device) attachment must remain secured.

(c) OSHA 29 CFR 1926.502(e)(2) states that, "Positioning devices shall be secured to an anchorage capable of supporting at least twice the potential impact load of an employee's fall or 3,000 pounds, whichever is greater."

4.0 POST-FALL AND RESCUE

Prolonged suspension from fall arrest systems can cause serious physical injury, or death. Research indicates that suspension in a fall arrest device can result in unconsciousness, followed by death, in less than 15 minutes. This is why a fall rescue plan is so critical.

To reduce the risk associated with prolonged suspension in fall arrest systems, plans to prevent prolonged suspension should be developed during the workplace assessment phase. The plan should include procedures for: **preventing prolonged suspension, identifying signs of suspension trauma, and performing rescue and treatment as quickly as possible.** To ensure prompt rescue, materials needed to affect a rescue shall be clearly identified on the fall protection work plan and staged in the work area.

Miller Fall Protection introduced the Relief Step Safety Device which is designed to assist a worker suspended in a full-body harness avoid the effects of orthostatic intolerance/suspension trauma. The Relief Step easily deploys when the worker activates a clearly-marked tab. The worker inserts one foot into the web loop-step enabling them to alternate between standing and hanging while awaiting rescue. This movement permits leg muscles to flex, stimulating blood flow and eliminating the cause of orthostatic intolerance/suspension trauma. The Relief Step Device should in no way be considered an alternative to developing an aggressive Rescue Plan. Employees who have fallen still need to be rescued as soon and efficiently as possible, primarily because they may be unconscious.

Regulatory agencies require employers to train workers to use fall arrest systems correctly while performing their tasks.

Individuals, who wear fall arrest devices while working, and those who may perform rescue activities, should also be trained in:

1. How suspension trauma may occur;
2. The factors that may increase a worker's risk;
3. How to recognize the signs and symptoms of suspension trauma; and
4. The appropriate rescue procedures and methods to diminish risk while suspended.

Rescue procedures must provide for prompt rescue of employees in the event of a fall or shall assure employees are able to rescue themselves. Rescue procedures should also address how the rescued worker will be handled to avoid any post-rescue injuries.

Rescue procedures should include the following contingencies based on actions:

1. If self-rescue is impossible, or if rescue cannot be performed promptly, the worker should be trained to "pump" his/her legs frequently to activate the muscles and reduce the risk of venous pooling. Relief Step Safety Devices or a rescue ladder can be used to alleviate pressure, delay symptoms, and provide support for "muscle pumping."
2. Continuous monitoring of suspended worker for signs and symptoms of suspension trauma.

3. Ensuring that a worker has standard trauma resuscitation once rescued.

4. If the worker is unconscious, keeping the worker's air passages open and obtain first aid.

5. Monitoring the worker after rescue, and ensuring the worker is evaluated by a health care professional.

NOTE: *If determined during the planning stages that an employee may be suspended for an extended period of time, the use of Relief Step Safety Devices should be seriously considered and added to the user's harness and made a critical element of the fall protection plan procedures.*

In the event of a fall or if some other related serious incident occurs* (e.g., a near miss), a full investigation into the circumstances shall be made to determine if the Fall Protection Plan needs to be modified (e.g., new/improved practices, procedures, or training). Those changes shall be implemented to prevent similar types of falls or incidents.

* Requires immediate notification to the District Manager, District Safety Manager and Sponsor. All personal fall protection equipment used in the arrest of the fall shall be tagged out and may be sent to the District Safety Manager. The anchorage shall be evaluated by a qualified person before it is permitted for use.

I. Rescue Planning

Work at heights will not be started without operation-specific emergency plans in place. Each project should already have a Crisis Communication Plan. The Crisis Communication Plan does not satisfy the objective of a post-fall rescue plan. The post-fall rescue plan must be developed by trained personnel who are familiar with the work being completed.

The emergency plan for work at heights must deal with each of the following issues:

A. Environmental and operation-specific factors which may affect rescue and evacuation operations, and how these factors are to be controlled.

B. The duties and responsibilities of each and every member of the crew in an emergency.

1. At least two members of each crew, a primary and a backup, should be well trained in basic procedures for assisting a suspended person.

2. The designated rescue personnel, a contact person and a means of contacting them must be identified.

3. A chain of command for on-site personnel must be established to control the emergency situation and to manage communication with and support for trained personnel.

4. Each Kiewit Project shall include in the emergency plan a communication path for contacting outside rescue services. The emergency plan shall list contact persons with telephone numbers. In many cases the emergency contact number will be 911 where Kiewit's employee will communicate the emergency for securing the appropriate rescue team.

C. The evacuation route shall be identified for employee safe travel to the designated assembly point in an emergency. This includes both the evacuation route to be taken when evacuating a site and the evacuation route for moving an incapacitated person to a safe designated assembly point for transport to medical facilities. These two evacuation routes are sometimes different.

1. The emergency plan should include backup evacuation routes to be used in case the primary evacuation route is blocked. Both evacuation routes should be clearly marked (if needed) so they are obvious even in conditions of poor visibility.

2. The equipment for evacuation must be available for use by those working at heights. Even if the plan indicates that outside rescue personnel (such as the fire department) be called in case of a rescue, rescue equipment must be at hand and trained personnel available to use it.

II. Selecting Components for Evacuation and Rescue

In the workplace assessment performed prior to selection of personal fall arrest systems, several factors should have been determined, including:

- The number of people who may need rescue or evacuation;
- The elevations from which rescue or evacuation will be effected;
- The elevations and directions (up or down) which must be reached by the rescue or evacuation system;
- Anchorages for a personal fall arrest system which may also be used to anchor a system for rescue or evacuation;
- Independent anchorages for a rescue or evacuation system in case those used for a personal fall arrest system are not usable.
- Rest steps or ladders for suspended employees.

Once these factors are determined, selection of primary rescue and evacuation devices and anchorage connectors may be made. These devices should not be used unless provided with significant training.

III. Selecting the Anchorage and Anchorage Connectors

Once the appropriate device or devices for rescue and evacuation are selected, the anchorage connectors must be identified. Rescue and evacuation will usually take place from designated areas. Anchorage connectors for the equipment should be installed at these locations so that emergency operations are not delayed in a search for a suitable anchorage and installing an anchorage connector.

The choice of anchorage connector is generally made from among the wide range of fixed anchorage connectors that are available, and include: the anchorage connector strap, band anchorage connector, installation snaphook, installation cable, eye bolt, tripod, davit and mounting bracket.

IV. Connecting and Using Rescue and Evacuation Systems

In most situations, movement of an incapacitated person should only be attempted by trained rescuers acting on competent medical advice. Rescuers must be trained to evaluate the extent of injury while working at heights and decide if movement of an incapacitated person should be attempted.

All members of the work team must receive hands-on training in all aspects of installation, rigging, use and inspection of rescue and evacuation systems under the guidance of a qualified person. Refresher training should be provided at regular intervals.

Equipment on-hand for potential rescues shall be inspected in accordance with the manufacturer requirements. A log of this equipment should be included in the fall protection work plan.

Any component used in rescue or evacuation must be immediately removed from service and the District Safety Manager called.

~ NOTICE ~

Purchasing rescue equipment is not as easy as a "one-size-fits-all rescue kit." Each option should be evaluated to make sure that the selected rescue equipment is compatible with the worksite demands.

The best way to appraise rescue equipment demands is to elicit the help of Project Safety Managers, the District Safety Manager and/or equipment manufacturers.

V. Summary

A. Rescue Considerations

1. Develop a post-fall recovery plan. Post fire/rescue phone numbers and plan an easy access route for outside response teams. Communicate with the designated rescue teams to ensure they are familiar with the project and site layout.

2. Inventory useful tools (ladders, scaffolds, manlifts, hoists, rescue winches, etc.) and their location before a fall occurs.

3. Avoid further injuries and falls by providing fall protection for both the rescuer and victim.

4. Minimize risk and communication problems by limiting the number of well-intentioned rescuers; establish criteria for qualified persons by crew, to act as lead responders.

If a post-fall recovery is needed, the following emergency measures may be activated to protect both the fall victim and intended rescuers.

- Communicate with the victim, establish the level of consciousness, and evaluate injuries. Comfort and monitor the victim continuously.

- Call emergency units, ambulance, fire/rescue. It is usually better to have too many rather than too few emergency units at the scene.

- Appoint a qualified person to take charge of the operation's overall safety. This person should be able to look at the whole picture, find weak points regarding both victim and rescuer safety, and be able to order changes when needed.

- Evaluate the scene:

  - Can the victim self-rescue?

  - Can rescuers gain access from the ground with ladders, manlifts or hoists?

  - If the first two options are infeasible determine the response time for a trained fire/rescue unit.

B. Incident Investigation

1. All incidents involving fall protection, regardless of nature, shall be reported and investigated. It is important that the investigation take place as soon as possible so that the root cause and means of prevention can be identified to prevent a similar incident.

   a) The District Manager, District Safety Manager and Sponsor shall be notified immediately when any employee or subcontractor employee suffers a fall.

   b) If an injury occurs the area must be secured until inspected by a higher authority on the job.

   c) Pictures will be taken above, below and at the area where the incident occurred. All pictures shall be sent into the District Safety Manager.

   d) All personal protective equipment worn by the employee shall be removed from service, tagged and sent to the District Safety Manager. The use of the anchorage shall be prohibited until a qualified person makes an inspection of the components.

2. In the event of a fall or some other related serious incident, this Manual and the operation's fall protection plan will be reviewed to determine if additional practices, procedures or training needs to be implemented to prevent similar types of falls or incidents.

5.0 FALL PROTECTION PLANS

5.1 SAMPLE FALL PROTECTION PLAN

KIEWIT COMPANIES

FALL PROTECTION PLAN

OSHA CFR 1926
Subpart M

PINNED COLUMN FORMS

Location: _____

Preparation Date: _____

Prepared By: _____

Superintendent: _____

Foreman: _____

Competent Person: _____

Job Sponsor: _____

A copy of this Fall Protection Plan with all approved changes is to be maintained at the Work Location, the Job Office, and a copy provided to the District Safety Manager. Any changes must be approved by the Job Sponsor. A copy of the plan revisions must be provided to the District Safety Manager.

Note: This example fall protection plan was used for an application where "foot level" tieoff was required.

POLICY

The Kiewit Companies is dedicated to the protection of all personnel at Kiewit job sites. All employees of the Kiewit Companies have a responsibility to work safely and to stop any work considered to be unsafe. A supervisor shall be notified immediately when an unsafe act or condition is observed.

PURPOSE

The purpose of this Plan is to:

A. Supplement our standard safety policies by providing specifically designed procedures to cover fall protection at this workplace; and,

B. Ensure that each employee is trained and made aware of the provisions to be implemented by this Plan prior to the start of work at bridge _____.

C. List or attach the specific material being called out as it relates to the equipment being used and include documents of inspection and training.

FALL PROTECTION PLAN

This Fall Protection Plan addresses the use of "other than conventional" fall protection for column forms for bridge _____, as well as identifying specific activities that require non-conventional means of fall protection. These activities include:

1. Bolt up.
2. Accessing the top of the column form.
3. Working on the top of the column form.
4. Working inside the column form.
5. Stripping columns forms.

Working on the top of column forms requires a specialized fall protection system. For this work, a conventional series of guardrails on the inside of the column walkway or a horizontal lifeline above waist height (± 36 inches) for lanyard connection cannot be applied as they are in direct conflict with the work and would place employees at a greater hazard.

This Plan is designed to assist Kiewit Companies, its employees and subcontractors to recognize the fall hazards in this operation and to establish procedures that are to be followed in order to protect workers from those hazards. Each employee will be trained in these procedures and be held accountable for compliance. In cases where compliance with these procedures would constitute a greater hazard, employees must stop work and notify their supervisor immediately. Any such concern will be addressed and resolved prior to resuming work.

Safety policies and procedures cannot be administered, implemented, monitored, nor enforced by any one individual. The total objective of a safe, injury-free work environment can only be accomplished with a dedicated effort of every individual involved with the work. Each employee must understand their value to the Company and the potential impacts of injuries. Employees must also understand safety policies and procedures and what their individual role and responsibility is within those policies. This allows for a more personal

approach to compliance through planning, training and understanding. A cooperative effort will achieve greater success, as opposed to one that requires strict enforcement.

It is the responsibility of the Superintendent, Foreman, and competent person (if different) to implement the Fall Protection Plan. They are responsible for observational safety inspections of their work operations and the enforcement of safety policies and procedures. When presented with a safety concern by an employee potentially affected by this Plan, the superintendent, foreman, and competent person will immediately stop work and institute corrective actions.

It is the responsibility of the employee to understand and adhere to the procedures within this Plan and to follow the supervisor's instructions.

PLAN REASONING

The use of standard guardrail systems, safety nets or conventional fall arrest systems are infeasible for this operation.

1. Guardrail systems are infeasible because they would prevent the employee from performing the operation. The guardrail would need to be placed along the circumference of both the inside and outside of the top of the column walkway. This would place the employee at a greater risk when placing concrete or hoisting materials.

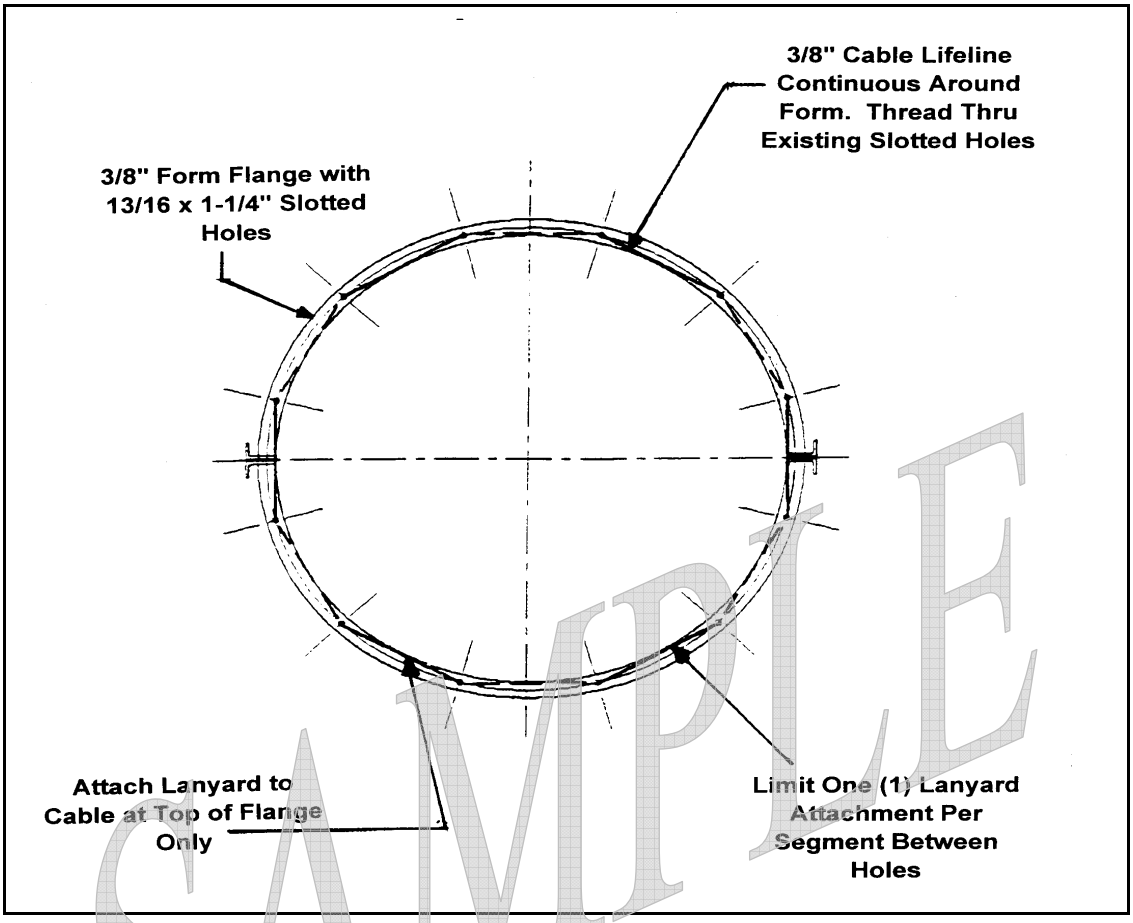
2. A safety net system is infeasible as there is no room to place one inside the column form. The use of a safety net would also interfere with the placement of column reinforcing steel and concrete.

3. Conventional fall arrest systems can be utilized where the column reinforcing steel is between 39" and 45" inches above the top of the form. However, there are more cases where this is not the situation and a system that provides an anchorage at waist height (±36 inches) would place employees in a pinch point and interfere with the reinforcing steel installation.

SYSTEM COMPONENTS

A horizontal 3/8-inch diameter horizontal lifeline cable (Bridon 6x19 IWRC EIP 15,100-pound minimum breaking strength wire rope), will be threaded through and secured to the top flange of the column form. Three (3) properly sized and spaced cable clips will be used to secure the end of the lifeline.

Lifeline on Column Form



Personnel will use a full body harness with either a retractable lanyard or a 4-foot shock-absorbing lanyard. A double leg "Y" lanyard is required in order to maintain connection during operations. The lanyard will be attached to the center D-ring in the middle of the employee's back.

A ladder attached to the column will be used to access the top of the column and will be equipped with a Ladder Climbing Safety Device (LCSD) or a retractable lanyard attached to an anchorage point at the top of the form. As employees enter the walkway they will be able to attach to the top of the column with the provided lifeline and then disconnect from the retractable.

A maximum of two (2) employees may be attached to the lifeline at any one time. Only one (1) employee may be connected to any line segment between holes on the top flange however. Employees are required to maintain connection to the lifeline at all times when on top of the column platform or when exposed to a fall hazard equal to or greater than 6 feet.

INCIDENT INVESTIGATION

Incidents or near misses that result or could have resulted in injuries to workers, regardless of their nature, shall be reported and investigated. It is an integral part of the Kiewit Companies Injury and Illness Prevention Plan that all incidents be investigated and documented as soon as possible after their occurrence so that preventive measures may be implemented.

In the event of a fall or some other related incident occurs, all related work shall stop and this Plan shall be reviewed to determine if additional practices or training is required so as to prevent a similar fall or incident in the future. The District Manager, District Safety Manager and Job Sponsor must be notified immediately of any such occurrence.

INSTRUCTION OF AUTHORIZED/DESIGNATED PERSONNEL

The following employees have been instructed in the provisions and requirements of this Fall Protection Plan and are authorized to work in the specified area(s).

Name	Craft	Signature	Date

Kiewit Companies

Fall Prevention/Protection Work Plan

Page _____ of _____

Operation/Specific Location of Worksite: **Date:**

Prepared By: **Competent Person:**

Identify fall hazards in work area:

Specific fall prevention or protection methods for workers exposed to a fall hazard:

___ **Standard Guardrail (top, mid & toeboard)** ___ **Double lanyard system** ___ **Horizontal lifeline**
___ **Anchorage capable of 5000lb load** ___ **Restraint Line** ___ **Vertical lifeline**
___ **Boom lift (Designated Operator Required)** ___ **Scissor lift** ___ **Safety Nets**
___ **Other (specify):**

Check equipment to be used:

___ **Full body harness** ___ **Shock-Absorbing lanyard** ___ **Fall Limiter**
___ **Positioning lanyard** ___ **Retractable lifeline (check certification)** ___ **Rope/Cable grab**

Describe procedure for assembly, maintenance, inspection and disassembly of system (identify individuals responsible for each item):

___ **Assembly** **Responsible** _____
___ **Maintenance** **Responsible** _____
___ **Inspection** **Responsible** _____
___ **Disassembly** **Responsible** _____

Describe procedure for handling and securing tools and equipment and over head protection for work areas below:

___ **Barricade**
___ **Canopy Protection**
___ **Watch (name person)** _____
___ **Other (specify):** _____

Describe method for prompt, safe rescue of injured worker:

___ **Relief Step Rescue Device**

Sketch of system (use additional paper if needed):

*** NOTE: If applicable, attach a copy of PE stamped designs for fall protection systems used in the operation.**

Ensure employees assigned to the tasks have received training and instruction on the items described above.
A copy of the training record shall be available at the work location.

Kiewit

MEMORANDUM

TO: Fall Solutions Manual User – Section A: Policy 6.0 (Training Guide)

DATE: June 2007

RE: Purpose of the Training Guide

The Training Guide portion of the Fall Solutions Manual accompanies the Fall Protection, "Train the Trainer" program. It is intended for supervisors who will educate employees on the basics of fall protection. While reading the manual will be very helpful, it is intended to be part of a one or two day classroom type setting. The training has both a classroom session and a hands-on session.

If you wish to have a Fall Protection, "Train the Trainer" program held for your Project contact your District Safety Manager.

6.0 TRAINING GUIDE

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THE VITAL NEED FOR FALL PROTECTION

Each year approximately 100,000 disabling injuries and 700 deaths are attributable to work-related falls. According to the National Safety Council, falls are one of the leading causes of death in the workplace. In addition to the lost lives and injuries caused by falls, US businesses lose millions of dollars each year from significant increases in insurance premiums, workers' compensation claims, product liability costs, and other related expenses. In short, a comprehensive fall protection program not only saves lives and reduces injuries, but also saves money and makes good business sense.

Recent statistics on falls are worse than those of previous years; fall fatalities have been rising by an average of 10 percent each year for the past decade, while overall work fatalities have been on the decline. On average, it takes close to a *thousand exposures* to a hazard to incur the consequences. For some victims, the fall is a death sentence.

REGULATORY MANDATES AND THE EMPLOYER'S RESPONSIBILITY

U.S. and Canadian regulations make it quite clear that it is the employer's responsibility to develop a fall protection program. The most effective programs are those where employers work closely with their workers to jointly develop a comprehensive fall protection program that either eliminates fall hazards or provides appropriate protection against them.

It should be noted that citations and fines have steadily increased due to noncompliance and negligence. However, those employers who take an active interest in their employee's well being and develop an appropriate fall protection program can avoid citations.

While regulatory compliance is important, preventing injuries and saving lives is our primary concern. A proper fall protection program can eliminate or seriously reduce on-the-job injuries and substantially minimize insurance costs and other related expenses.

Resources for Regulation, Advisement's, and other Materials Pertaining to Fall Protection

General Industry – OSHA

Guarding Floor and Wall Openings & Holes	1910.23
Fixed Industrial Stairs	1910.24
Portable Wood Ladders	1910.25
Portable Metal Ladders	1910.26
Fixed Ladders	1910.27
Ladder Safety Devices	1910.27(d)(5)
Safety Requirements for Scaffolding	1910.28
Manually propelled Mobile Ladder Stands & Scaffolds	1910.29
Vehicle-Mounted Elevating & Rotating Work Platforms	1910.67
Manlifts	1910.68
Permit-Required Confined Spaces	1910.146
Overhead & Gantry Cranes	1910.179

Construction – OSHA

Safety Training & Education	1926.21
Personal Protective Equipment	1926.28
Safety Belts, Lifelines & Lanyards	1926.104
Working Over or Near Water	1926.106
Scaffolds	1926.450
Aerial Lifts	1926.453
Fall Protection	1926.500
Specific Excavation Requirements	1926.651(1)
Stairways & Ladders	1926.1050

ANSI Standards

Fall Protection Systems	A10.32 & Z359
Ladder Safety Devices	A14.3
Personnel and Debris Nets	A10.11
Confined Space	Z117.1
Definitions	Z359.1

WHAT IS FALL PROTECTION

Fall protection is the backup system planned for an employee who could slip, trip, or fall at a height; its purpose is to eliminate or reduce the potential for injury. In general, fall protection is a planned response to foreseeable fall hazards. At a minimum it can be applied to:

1. Performing the work at grade level thereby avoiding the need for fall protection.

2. Minimizing the fall distance to a working surface by using a scaffold platform, an aerial platform, or a workbasket, for example.

3. Installing guardrail or handrail systems.

4. Using personal fall protection equipment with pre-designated anchorage points that fit the required task mobility, including travel to and from the work area.

Fall hazard distance begins at, and is measured from, the level of the workstation onto which a worker must initially step, and where a fall hazard exists. It ends with the greatest distance of possible continuous fall, including steps, openings, projections, roofs, and the direction of fall (interior or exterior). Protection is required to keep workers from striking objects and to avoid pendulum swing, crushing, and impact with any body part that is vulnerable to serious injury.

The objective of elevated fall protection is to convert the hazard to a slip, or minor fall at the very worst – a fall from which, hopefully, little or no injury occurs.

There are two types of elevated fall exposures:

1. **DURING WORK:** Elevated work is an integral part of a job and is often associated with heavy construction, maintenance, utility work and many others.

2. **DURING ACCESS OR EGRESS:** In other cases, exposure to a fall hazard occurs simply while the employee is accessing an elevated work area.

SLIPS, TRIPS AND FALLS FROM ELEVATION

Unlike other types of incidents, falls rarely involve near misses, from which people can be warned or learn about the consequences. It is reasonable to assume that some disabling injury occurs with nearly every accidental and uncontrolled fall. That injury is frequently permanent.

Falls are classified into four general categories: slips, trips, falls on stairs, and falls from elevation. Slips and trips occur on the same level. Stair and elevated falls occur from one level to another.

The frequency of slips and trips tends to be very high; however, injuries typically consist of severe sprains or strains and possible broken bones. So, if falls on the same level can produce severe injuries, certainly each foot above ground level increases that likelihood.

HOUSEKEEPING

Poor housekeeping, such as blocked walkways and access areas, exposed electrical cords, and uneven working surfaces, are a few conditions that often produce trips. A poor, unplanned physical layout can promote dangerous shortcuts. Timely housekeeping can control the variables, and a plan for material placement and storage can limit trip falls on our work. ***A clean site is a safe site!***

FALLS FROM ELEVATION

Fall hazards at heights should be engineered out at the planning stage whenever possible. Remaining hazards deserve a backup system for when the employee forgets or momentarily loses control. Eventually, conditions will combine to produce the scene for a dangerous fall, one that is entirely preventable, in almost every case, if workers follow proper procedures.

WHEN DO FALLS OCCUR

Industrial falls can take place during a variety of elevated work. The Bureau of Labor Statistics (BLS) determined that loading and unloading material was the most common activity at the time of the fall (17%). Ten percent were performing carpentry tasks. Other reported activities mainly consisted of work tasks associated with construction activities.

Participants in the study were asked to describe their specific movements at the time of the fall. Twenty eight (28) percent said they were climbing up or down from an elevated position or location. Thirteen (13) percent said they were walking; eleven (11) percent were stepping from one surface to another; and ten (10) percent were moving backwards.

The primary structures from which the victims fell were ladders, roofs or decking, and scaffolds.

ANALYSIS OF ALL CONSTRUCTION FATALITIES

1. Fall from elevation 33%
2. Struck by 22%
3. Caught in/between 18%
4. Electrical shock 17%
5. Other 10%

HOW TO START A FALL PROTECTION PROGRAM

Fall protection requires a Total Systems Approach. In order to be effective, all parts of the system must be in place and working together. The following factors must be addressed when developing a successful fall protection program. The superintendent is responsible to ensure the operation is adequately planned, well in advance of the operation start, and includes all requirements listed below.

Hazard Identification

A well conceived fall protection program begins with identification of all potential fall hazards in the workplace. As a rule, any time a worker is at Kiewit's trigger height of 6 feet or greater, a potential fall hazard exists and appropriate Personnel Fall Protection System implemented. Where a fall hazard exists, there are two acceptable options: (1) eliminate the hazard, or (2) provide protection against it. Ideally, it is best to eliminate the hazard. Since elimination is often not feasible, other measures such as the wearing of personal protection equipment (PPE) may be required.

Written Fall Protection Program

Following hazard identification, a written program should be developed specifying how to deal with each hazard. If standardized safe work practices and operating procedures can eliminate the hazard, then such procedures should be specified.

Where hazard elimination is impossible, the program should state what fall protection measures are to be used, how they are to be used, and who is responsible for overall supervision and training. This program does not need to be elaborate, but it should cover the basics with the essential elements clearly conveyed and understood by all participants in the program.

Equipment Selection

As the employer, we must know the types of fall protection equipment available, and decide which would be most suitable for the workplace. Because all work environments differ, it is impossible for the equipment manufacturer to determine exactly which fall protection products will provide maximum protection for each task. By understanding how fall protection products operate and knowing the differences in product functions, we can select the best fall prevention and protection equipment available. Fall prevention and protection equipment shall be used consistent with the manufacture's recommendation and every effort afforded so as not to mix equipment from various manufacturers.

Training

All Kiewit employees must be trained in the proper use of fall prevention systems and/or fall protection equipment before use. ANSI Z359 Standards identify the role employees may be categorized from Authorized Person, Competent Person and Qualified Person (see part 2.1 definitions). Employees must be able to identify potential fall hazards and determine which systems or equipment to use in specific work environments.

A. HAZARD IDENTIFICATION

Identifying hazardous fall exposures begins by listing the work tasks that involve or could involve exposure to an elevated fall hazard. Hazard identification associated with fall exposures should be identified in the pre-planning stages. It is important to reemphasize that this should also include travel to and from the work location.

Workers at an elevated work location, who may become trapped in an emergency situation (tower cranes, etc.) should not be overlooked. An emergency escape system may be necessary as a primary or secondary means to automatically control descent for emergency egress.

As a minimum, hazardous work tasks should be identified by name and location prior to any work being done, so a comprehensive review can be accomplished.

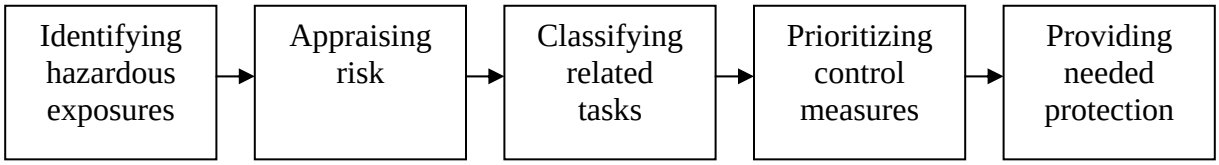
APPRAISING RISK

After identifying the individual elevated work tasks, appraising each exposure against a specific set of criteria enables the assessment of the relative risk. The appraisal should include:

- An assessment of vertical and horizontal movement.
- The number of workers involved.
- How often the task is performed.
- The length of time typically spent on the task.
- A general description of the work area, with particular attention to potential obstruction in the fall path.
- A post-fall analysis to review expected self-recovery or the possible need for retrieval and rescue.
- Identification of influential environmental conditions, such as icy or wet surfaces, high winds, etc.

Overall, the objective is to pinpoint the most frequent tasks with the highest potential severity. Assigning a value to each criteria and then ranking them may be an effective means to prioritize exposures for control measures.

Analyzing a fall hazard takes these five steps.



Errors by skilled workers in construction trades are often related to unusual conditions, which can combine to surprise a normally careful worker's lack of awareness or knowledge in a particular situation.

CLASSIFYING RELATED TASKS

Classifying related work tasks can assist in the development of elevated fall hazard control measures. As in the appraisal process, a list of criteria is compiled. "Climbing on fixed structures," for instance, could be used to group all fixed ladder climbing, regardless of whether the ladder was on a building, batch plant, crusher or column. Other considerations, such as horizontal movement, frequency, plant location, number of employees, or the need for emergency escape often represent additional essential criteria.

PRIORITIZING CONTROL MEASURES

Once they are classified, exposures are prioritized for control measures. To begin reducing the probability of a fall, elevated work tasks with high risk and reasonably straightforward will be resolved immediately. For example, a new steel girder bridge over a river could have a sequence of erection where nets and horizontal lifelines are installed onto beams at barge levels.

The fall hazard height should also be used to prioritize control measures along with the frequency, duration, and potential severity.

The analysis is intended to determine the most suitable match between required worker mobility and the capabilities of the fall protection system.

PROVIDING NEEDED PERSONAL PROTECTION

Whatever is selected should minimize the potential for personal injury, without sacrificing productivity. Consulting with the project safety supervisor, District Safety Manager, and/or reputable Manufacture's representative (Bacou-Dalloz, MSA, or DBI Sala) may be necessary for selecting the appropriate personal protective equipment.

ANALYZING THE WORK AREA

One of the first steps in analyzing the work area should be the review of plans before work begins on the site. By addressing the fall hazards at this stage, we are better prepared to provide fall protection to our employees. Next, if the job has already started, make a walk through specifically for identifying existing fall hazards. Last, but not least, remember to anticipate upcoming fall hazards as the work progresses.

Fall Hazard Planning Checklist

The following is a checklist to assist in the efforts for full fall prevention/protection and can be used at any stage of the construction process.

1. Begin the process by identifying areas where fall exposures already exist, such as:

    a. Scaffolds,
    b. Ladders,
    c. Roofs and roof openings including skylights,
    d. Open sided floors and floor openings,
    e. Steel erection,
    f. Aerial lift platforms,
    g. Permanent and temporary working platforms,
    h. Excavations,
    i. Leading edges/unprotected edges,
    j. Hoist areas,
    k. Ramps, runways, and walkways,
    l. Wall openings,
    m. Stairways,
    n. Working over dangerous equipment,
    o. Potential for falling objects,
    p. Formwork,
    q. Pre-cast and lift slab erection and,
    r. Housekeeping concerns.

2. Is it possible to provide or install fall prevention measures before there is an exposure?

    a. Install guardrails before allowing employees on an unprotected level.
    b. Don't cut floor openings until prepared to install the specified object.
    c. Attach a retractable lanyard to the top of a column forms before standing the column.

3. Have alternate work methods been proposed or implemented, such as:

    a. Connecting steel or concrete from articulating boom lifts or aerial work platforms.
    b. Assembling structures, horizontal lifelines or guardrail systems on the ground and lifting them into place to eliminate exposure to falls.

4. If work is already in progress, is there a completed survey of the operation to identify where/what the fall hazards are?

5. Specify fall prevention/protection measures when ordering materials or items, such as:

    a. Stair systems, ramps or walkways with guardrails pre-installed.
    b. Structural steel members with adequate anchor points for personal fall arrest systems.
    c. Ensure equipment and work platforms have fall protection engineered into the design.

6. For personal fall arrest systems, evaluate the following:

    a. Anchor points identified and capable of supporting 5,000 lbs. per employee or two times the intended impact load?
    b. Swing hazards being addressed when choosing anchor point locations.
    c. Anchor heights adequate for systems in use?
    d. Shock absorbing lanyards or retractable lifelines being used so employees will not be exposed to forces greater than 1,800 lbs.

7. Are employees selected and trained to work at heights safely?

8. Have rescue methods and procedures been established in the event of a fall?

B. WRITING THE FALL PROTECTION PROGRAM

How to Organize a 100 Percent Fall Protection Program:

- Should fall protection always be provided?
- What is 100 percent protection?
- Can 100 percent fall protection be achieved?
- Develop an effective fall protection program:
    - Establish policy and develop rules
    - Conduct a fall hazard analysis
    - Determine appropriate hazard control measures
    - Selecting, orienting, and training personnel
    - Emergency and self-rescue issues
    - Inspection and maintenance of equipment
    - Program audit and feedback
- Additional considerations for confined entry operations.

Should Fall Protection Always Be Provided

If we start with the objective of 100 percent and then work toward that goal, it will be achieved. The effectiveness of protection is usually dependent on the degree of planning that occurs before the job begins. Fall incidents should decrease in proportion to the planning commitment. Over time, and through discipline and accountability, fall protection ultimately becomes as simple as "hooking up."

What is 100 Percent Fall Protection?

If 100 percent fall protection is the goal, it means that no exposure to an elevated fall hazard is permitted without backup protection. It means a trigger height of 6 feet and less if protection of hazards cannot be achieved. It means continuous protection. Exposure can be prevented, by: (1) eliminating the circumstances that expose the employee to a fall; (2) performing the work at grade; (3) establishing walls, floors, and guardrails; (4) using work platforms and aerial lifts; (5) instituting an operational change; or (6) restricting worker travel. Hazardous areas can be identified by installing warning lines six feet or more from an exposed edge.

When the prevention of fall hazard exposure is not practical to the work method, personnel nets or personal fall protection equipment can be designed to mitigate the effects of elevated falls.

Each work method and elevated work task should be examined completely. Outside of specific personal fall arrest equipment and its anchorage, planning what to do after a fall occurs is often overlooked or left up to a "rescue" operation. Much can be done to eliminate the injuries incurred after a worker falls, as well as devising methods that allow the worker a means of self-rescue.

THE WRITTEN FALL PROTECTION PROGRAM

As an employer we must provide fall protection for everyone on the job and make sure all walking and working surfaces will safely support all of our employees. The first step in doing this is the development and communication of a fall protection program. A fall protection program should include, at least, the following:

1. Management's commitment, leadership and employee involvement
2. Full worksite analysis
3. Hazard prevention and control measures
4. Safety training
5. Accident investigation
6. Accountability and enforcement, and
7. Rescue procedures

The true purpose of the program is to identify, manage and control all fall hazards by eliminating them with fall prevention methods. The written fall protection program needs to address how we will manage and control existing fall hazards. The written program can be very detailed or rather simple and direct, depending on job site exposures.

C. UNDERSTANDING AND CALCULATING FALL ARREST FORCES

Elements of a Fall Hazard

If we consider that a hazard is the potential to incur harm, what is it about falling that makes it so dangerous? Many people are quick to point out "It's not the fall that hurts you, it's the sudden stop!" That sudden stop at the end, actually the lack of adequate shock absorption at impact, is one of the three main elements of a fall hazard.

The following elements combine to make a fall hazardous:

- Free-fall Distance
- Shock absorption at impact
- Body weight

Free-fall Distance

If falls on the same level can produce injury, certainly each foot above the working level increases that likelihood substantially. Therefore, the free-fall distance becomes a critical element of the hazard. Free-fall distance refers to the uncontrolled distance of travel before the person either reaches grade level or the fall arrest equipment is activated.

Free-fall and deceleration with fall equipment is also most easily measured from foot level before the fall to foot level after the fall. A 6-foot lanyard, for instance, attached at foot level or below, could result in a free fall of 12 feet before the equipment is activated. Since free falling is a transfer from potential energy to kinetic energy, the longer the free-fall distance, the higher the forces generated on impact.

Free-fall Distance – The distance of the fall from the point of the attachment to the activation of the deceleration device. This distance should not be more than 6 feet.

Deceleration Distance – The distance from the activation of the deceleration device to a complete stop.

Total Fall Distance – The combination of the free-fall and deceleration distances, plus any other conditions, such as a sliding D-ring on a harness.

Shock Absorption at Impact or Fall Arrest Dynamics

Shock absorption among different types of personal fall arrest equipment can vary considerably. Use of a shock-absorbing lanyard and full body harness combination not only can substantially reduce the probability of a compounding injury, but can also permit users to self-rescue from a majority of falls from an elevation.

Body Weight

The third element that makes falling so hazardous is the weight of the employee. At heights, this is of particular concern for workers (to include tools) who weigh more than 310 pounds. The concern stems primarily from the need to support the body properly during a fall arrest. Overweight users tend to have larger stomachs and waistlines that "disappear", which makes adjusting a body harness properly, extremely difficult, if not impossible. Falls are usually much more severe and disabling for heavier persons due to potential for internal injuries.

FALL FORCE LIMITS

OSHA has established maximum limits of force that the body can be exposed to in the event of a fall. The maximum force is **1,800** pounds. Kiewit Company's policy states the maximum force to be **1,000** pounds, as required in the ANSI Standards, A10.32-2004 Standard.

FALL FORCE CALCULATIONS – VERTICAL Fall Arrest Force's (FAF's)

The following equations provide a relatively simple way to calculate the average fall arresting force (FAF) a worker will be exposed to in the event of a fall.

$$\textbf{Average Fall Arresting Force} \cong \frac{\textbf{(Weight)(Velocity)}}{\textbf{(Gravity)(Time)}}$$

Weight = Weight of the worker (Measured in pounds)

Time = Stopping time (From initial deceleration to completed fall arrest)

$$\textbf{Velocity} = \sqrt{\textbf{(2)(gravity)(height)}}$$

Gravity = 32.2ft/s^2

Height = Free fall distance of the worker (measured in feet)

Example 1: The following is based on a 220 pound man, free falling 6 feet into a nylon rope lanyard. We must first calculate the velocity. This is done using the above equation, factoring in our 6 foot free fall and the pull of gravity.

$$\text{Velocity} = \sqrt{(2)(32.2\ \text{ft/s}^2)(6\ \text{ft}) = 19.65\text{ft/s}}$$

Now, utilizing our average FAF equation, we calculate the force generated in the above example. For our example, we have estimated the stopping time associated with a 6-foot nylon rope lanyard to be .05 seconds. This estimate is based on actual lab tests.

$$\text{Average FAF} \cong \frac{(220\ \text{lbs.})(19.65\ \text{ft/s})}{(32.2\ \text{ft/s}^2)(.05\text{s})} = 2{,}685\ \text{pounds}$$

The fall arrest force in this example is 2,685 pounds (which exceeds OSHA's allowable Maximum Arresting Force of 1,800 pounds).

*** This is why Kiewit does NOT allow rope lanyards.**

Example 2: The following is based on a 220 pound man, free falling 2 feet into a nylon rope lanyard.

$$\text{Velocity} = \sqrt{(2)(32.2\ \text{ft/s}^2)(2\ \text{ft})} = 11.35\ \text{ft/s}$$

$$\text{Average FAF} \cong \frac{(220\ \text{lbs.})(11.35\ \text{ft/s})}{(32.2\ \text{ft/s}^2)(.05\text{s})} = 1{,}550\ \text{pounds}$$

The resulting fall arrest force in this example is 1,550 pounds (which is within OSHA's requirements). What variable did we change? We minimized the free fall distance, which in turn reduced the fall arrest force to within acceptable limits.

Another way to reduce the FAF on a worker is to reduce the weight of that worker. Unfortunately, weight will be the most difficult variable to control. One way of reducing the weight would be to carry only those tools necessary for the task.

The last variable we can control is stopping time. If we can increase the amount of time it takes to bring our free falling employee to a complete stop, then we can decrease the average FAF. We do this by increasing the stopping distance through the use of a shock absorber or raising the height of the anchorage.

Example 3: The following is based on a 220-pound man, free falling 2 feet into a nylon rope lanyard with an integral shock absorber.

$$\text{Velocity} = \sqrt{(2)(32.2 \text{ ft/s}^2)(2 \text{ ft})} = 11.35 \text{ ft/s}$$

$$\text{Average FAF} \cong \frac{(220 \text{ lbs.})(11.35 \text{ ft/s})}{(32.2 \text{ ft/s}^2)(.09\text{s})} = 861 \text{ pounds}$$

In conclusion, by ***reducing the weight, minimizing the free fall distance, and maximizing the amount of time taken to stop*** we can reduce the average FAF to within acceptable limits.

(*Note: The times, .05 and .09 seconds, are examples ONLY. Actual stopping time is dependent on the amount of stretch provided by a given lanyard. All lanyards will have a different amount of stretch based on the type, diameter and condition of material; as well as the specific construction of a given style of lanyard.)

CALCULATING FREE FALL DISTANCE AND TOTAL FALL CLEARANCE

OSHA states that personal fall arrest systems shall be designed and used such that an employee can neither free fall more than 6-feet nor come in contact with any lower level. Limiting free fall to 6-feet is not as simple as using 6-foot or 4-foot lanyards.

Example 1: An employee is wearing a full body harness with the D-ring positioned 5 feet above the floor, attached is a 6-foot lanyard. If the employee attaches the lanyard to an anchor point at his feet, and falls over the open sided floor, he will be exposed to a free fall of approximately 11 feet.

D-ring Height	5	Feet	(From working surface)
Lanyard Length	+6	Feet	
Anchor Point Height	-0	Feet	(From working surface)
Total FREE FALL Distance	11	Feet	(Violates OSHA Law)

Example 2: An employee is wearing a full body harness with the D-ring positioned 5-feet above the floor, attached is a 6-foot lanyard. If the employee attaches the lanyard to an anchor point 6-foot above the floor, and falls over an open sided floor, he will be exposed to a free fall of approximately 5 feet.

D-ring Height	5	Feet	(From working surface)
Lanyard Length	+6	Feet	
Anchor Point Height	-6	Feet	(From working surface)
Total FREE FALL Distance	5	Feet	(Complies with OSHA Law)

To minimize the free fall distance the employee should:

1. Secure the lanyard to an anchor point at or above the height of the D-ring (anything lower than 36 inches must be approved by the Job Sponsor), whenever possible.

2. Use a shorter lanyard or use a retractable lanyard when the first option is not feasible. But NEVER allow for a free fall of more than 6 feet.

In addition to limiting the free fall distance to not more than 6 feet, we must also calculate the TOTAL fall clearance to avoid hitting the ground or the next lower level. This is especially important when utilizing shock absorber type lanyards. These lanyards may elongate as much as 42 inches (maximum permitted by OSHA) during the deceleration process. An employee of average height (6 feet), using a 6-foot shock-absorbing lanyard and a full body harness, must attach to an anchor point at least 15½ feet from the ground or next lower level. In addition, you should also factor in D-ring slide and the possibility of an improperly fit harness. Due to these things it is often recommended adding a safety factor to your fall clearance calculation. A safety factor of 3 feet. is recommended.

In order to correctly calculate the TOTAL fall clearance you must know the following:

1. Height of employee
2. Length of lanyard
3. Deceleration Distance (Expansion of shock absorber)
4. Height of anchorage
5. Extension of anchorage connector (Cross arm strap, etc.)
6. Safety factor
7. Amount of deflection if using a horizontal lifeline.

Free Fall Distance for various Shock-Absorbing Lanyard lengths and Elevations or Anchorage Connection Point

	Length of Shock Absorbing Lanyard			
Distance of Anchorage Connection Point Above (+) or Below (-) Harness Fall Arrest D-Ring	**6'**	**5'**	**4'**	**3'**
+3	3	2	1	0
+2	4	3	2	1
+1	5	4	3	2
0	6	5	4	3
-1	7	6	5	4
-2	8	7	6	5
-3	9	8	7	6
-4	10	9	8	
-5	11	10		
-6	12			
	TOTAL FREE FALL DISTANCE*			

** Does not include deceleration distance (maximum 3.5 feet).*

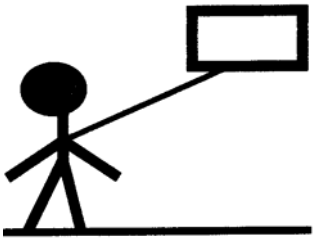
Fall distance is not always measured from the working surface to the ground, because the ground is not always the closest object beneath the working platform. If there is any type of obstruction in the fall path of the worker, the available clearance is measured to the top of that obstruction. Sometimes these distances can be very short, whereby the use of 4' or 6' lanyards would be impractical. Obstructions often encountered beneath the working platform are exposed rebar, scaffold tubing, forms, etc.

Free Fall Distance can become more complex than those shown here. The numbers and variables will change depending on the type of Personal Fall Arrest System used. For example, when calculating Total Fall Distances for Horizontal Lifeline Systems you have additional variables to consider, such as cable deflection and the number of people on the system.

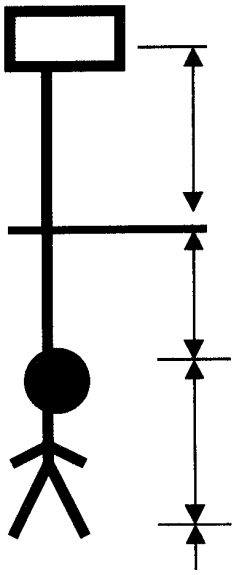
The important thing to remember is that calculating Total Fall Distance is just as important as selecting the right equipment for the job. Forgetting to calculate Total Fall Distance is just as dangerous as failing to wear your harness before working, at any elevation.

FALL CLEARANCE CALCULATION

BEFORE FALL



POST FALL



Total: 18½' from anchor point.

A worker (who is six feet tall) is using a personal fall arrest system consisting of a D-bolt anchor, a 6' shock-absorbing lanyard (deceleration distance of 3.5') and a full body harness. When he attaches his shock-absorbing lanyard to the D-bolt on the I-beam above his head; the minimum acceptable distance between his anchor point (the D-bolt) and the next lower level is 18½ feet.

Fall Clearance Calculation

6ft.	Lanyard length
6ft.	Height of worker
3.5ft.	Extension of shock absorber
3ft.	Safety Factor
18.5ft.	Minimum recommended fall clearance

D. SELECTING PROPER ANCHORAGE POINTS

It is important to remember that fall protection is only as good as its anchorage. It doesn't matter how well trained personnel are, how good the equipment is, or whether or not the employee is attached correctly. If the anchor point fails, nothing in the system will work.

STRUCTURAL REQUIREMENTS

All anchor points for personal fall arrest and positioning systems must meet minimum structural requirements. There are different requirements depending on the approach taken in selecting anchor points. The following are the minimum structural requirements for anchorage points.

1. All anchorage's must be capable of supporting, without failure, an impact load of 5,000 pounds/person, or;

2. The anchorage must be capable of supporting two (2) times the maximum intended impact load, this must be determined by a qualified person.

3. For positioning and restraint systems, all anchor points must be capable of supporting 3,000 pounds/person without failure.

ENGINEERED ANCHOR POINTS

To determine twice the intended impact load for an anchorage, a professional engineer or qualified person must determine the impact load of a falling employee, and ensure the anchor will support twice this load.

For example, if it is determined that the maximum impact load of a fall will generate 1,400 pounds, then the anchor point must be capable of supporting 2,800 pounds. This is a safety factor of two (2), which OSHA requires. Following is information that should assist the qualified person in engineering anchor points.

- Steel members should be used for anchor points whenever possible.

- Expanded anchor points have been successfully used in pre-cast operations but should be inspected by a qualified person.

- Through bolts and plate washers should be inspected by a qualified person.

- Additional systems that can be used as anchor points include, shackles, turnbuckles, imbeds, eyebolts, beam clamps and slings, or cross over straps and should include stamped drawings with load ratings of all components. (Note: Any components used in a fall protection system shall not have been previously used for other job tasks).

- All components must be rated for the design of the system. Crosby, USA, and or Forged manufactures are recommended for components.

LOCATION

The proper location of anchor points is critical to the employee's safety in the event of a fall. In order to avoid all hazards, the following guidelines should be followed:

- The anchor point should limit the fall to the shortest possible distance (must limit free-fall to 6 feet).

- The anchor point should be located above the employee's head, when engineered lifelines are used consideration should be given to waist level tie off.

- Installation of anchor points near electrical lines or life threatening areas shall be avoided.

- It should be located so that in the event of a fall, the employee does not swing into other objects.

- The anchor point should not be located on structures supporting personnel.

- The total fall distance should be considered when selecting anchor points to ensure adequate clearance in the event of a fall.

- Anchor points should be selected by someone capable of determining the anchor's ability to withstand the 5,000-lb. requirement (qualified person). If you are engineering use a minimum safety factor of 2 per the number of people to be attached.

- When practical, anchorage points should be color-coded or identified in such a manner that employees can easily determine if the point is acceptable.

- Anchorage point should be placed in such a spot to allow for easy rescue should a fall event occur or add an anchorage for rescue personnel.

IMPROPER ANCHOR POINTS

There are a number of fatalities each year where employees are connected to inadequate or improper anchor points. The following are areas that should never be used as anchor points.

- Standard guardrails;
- Ladders/ladder rungs;
- Scaffolding;
- Conduit;
- Another lanyard;
- Another retractable;
- Rebar (Unless structurally designed)
- Any point that does not meet the structural requirements.

HORIZONTAL LIFELINE FALL ARREST SYSTEMS

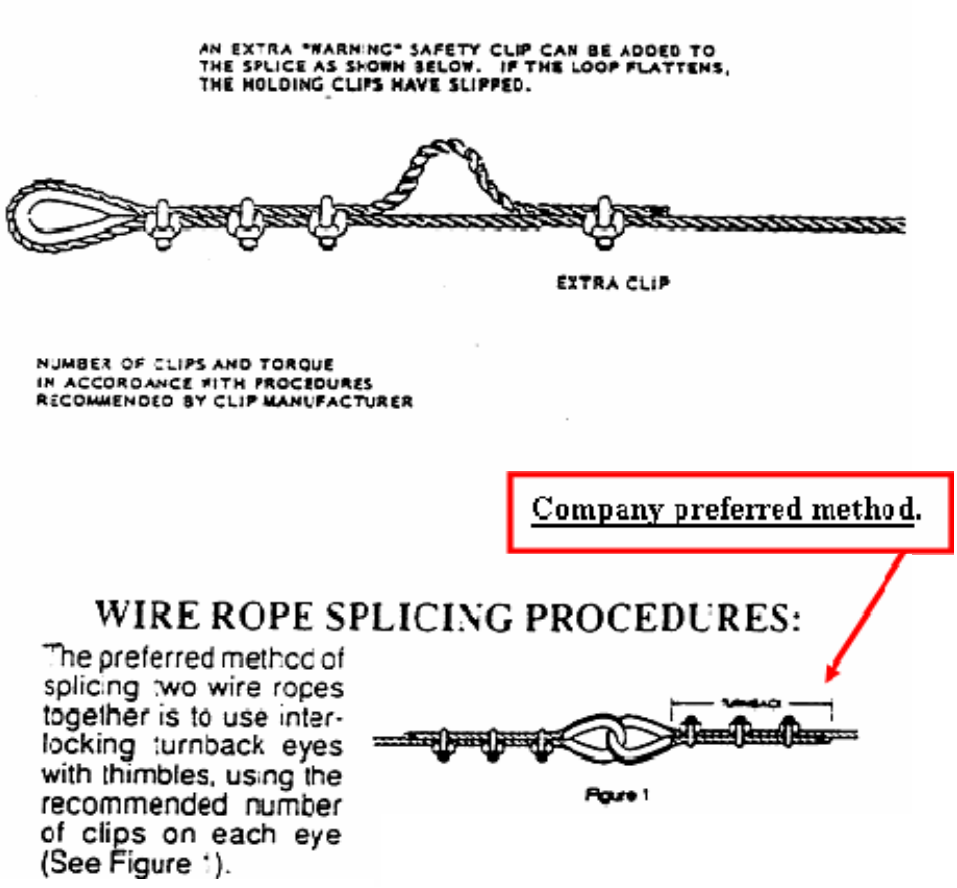
(1) 29 CFR 1926.502(d) states that, **"Horizontal lifelines shall be designed, installed, and used under the supervision of a qualified person, as part of a complete personal fall arrest system, which maintains a safety factor of at least two per person connected."** All horizontal lifeline systems must, therefore, be designed and stamped by a registered professional engineer.

(2) The system is designed to accommodate two (2) employees with a combined tool and body weight of 310 pounds each. ***It is very important to communicate this limitation to the crews and to explain the potential of two employees striking each other.***

(3) Total fall distance, including cable sag, lanyard deployment, and "free fall," must be calculated and any resulting impact hazards addressed. Post fall retrieval methods must also be addressed and included as part of the Fall Protection Plan.

(4) The "anchorage" point is where a lanyard attaches to the lifeline. All anchorage points must be designed under the supervision of a qualified person. (The OSHA 5,000-pound anchorage requirement does not apply to the location where the aircraft cable is attached.) Cable attachment points must be designed to support the forces that could be applied, and must be equal or greater than the ultimate breaking strength of the cable.

(5) When using wire rope for horizontal lifelines, splicing must be formed using interlocking turn back eyes with thimbles, with the recommended number of fist grips on each eye. (Note: Kiewit prefers the use of fist grips in lieu of traditional U-bolt cable clamps.)



OVERVIEW OF PERSONAL FALL ARREST SYSTEMS (PFASs)

A comprehensive fall protection program must be viewed as a total system. Beginning with hazard identification and ending with ongoing management review. A personal fall arrest system (PFAS) can be viewed as a system within a system. Three key components of the PFAS must be in place and properly used to provide maximum worker protection.

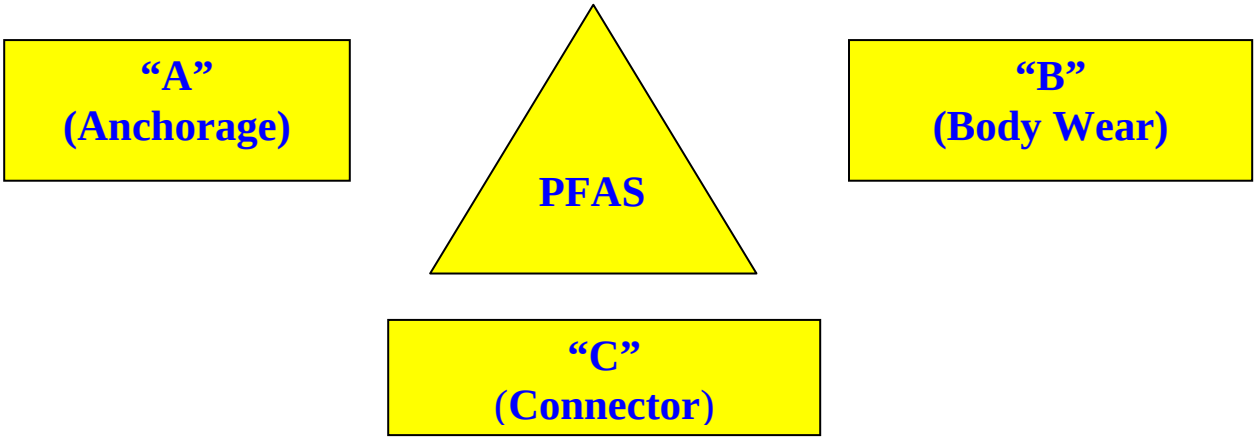
A. Three System Components

1. **Body Wear:** The first component of the system is the personal protective equipment (PPE) worn by the employee. The only body wear allowed for fall arrest is a full body harness. A harness should be selected based on the employees work environment and the type of work he/she will be performing.

2. **Connecting Devices:** The second system component is the connecting device. This device can be a web lanyard, rope grab or retractable lifeline. However, Kiewit's policy dictates the use of shock-absorbing web lanyards because they significantly reduce the forces generated in a fall.

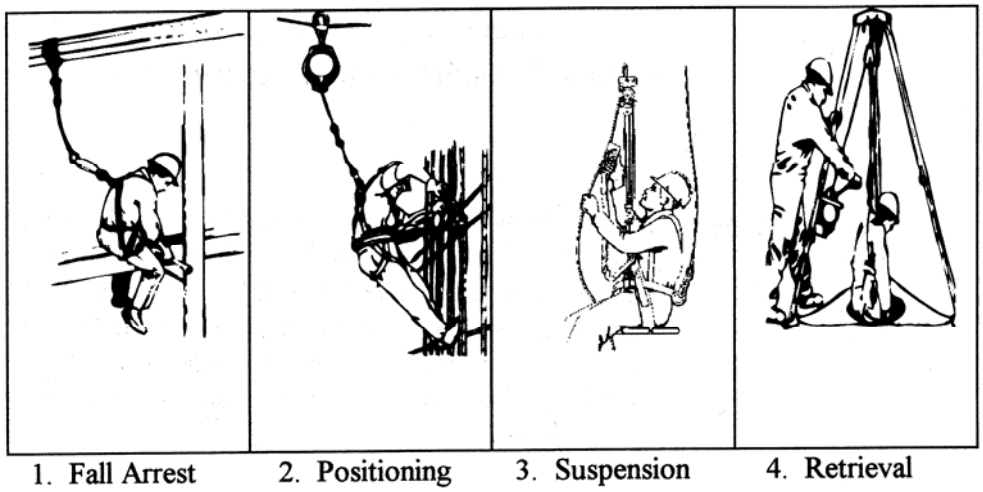
3. **Anchorage Connectors and Anchor Points:** The final component of the system is the anchorage connector and anchor point. This component must be capable of supporting 5,000 pounds per worker or designed, installed, and used under the supervision of a qualified person as part of a complete PFAS, which maintains a safety factor of at least two. Examples are eyebolts, support beams cross-arm straps, beam trolleys, beam clamps, etc.

Individually, none of these three components will provide total protection from a fall. Used properly in conjunction with each other they form a personal fall arrest system and become a critically important part of the total fall protection system.



B. Four Functional Equipment Categories

Fall protection equipment may be broken down into four functional categories, which are identified by the following symbols.



FALL ARREST

A personal fall arrest system is required if any risk exists that a worker may fall from any elevated surface or position.

As a rule, it is recommended that a PFAS be used any time a working height of 6 feet is reached and a fall hazard exists. Working height is defined as the distance from the walking/working surface to a grade or lower level.

A PFAS is designed to be "passive" and will only come into service should a fall occur. The following equipment should be used as a part of a personal fall arrest system.

A. **Personal Protective Gear**: Full body harness.
B. **Connecting Device**: Shock-absorbing lanyard or retractable lifeline.
C. **Anchorage/Attachment Point**: 5,000-lb. static load tested anchor point and anchorage connecting device.

Regulations require fall forces be limited to 1,800 pounds or less when wearing a full body harness.

A full body harness distributes the forces evenly throughout the entire body reducing the chances of internal injuries. The shock-absorbing lanyard dramatically decreases the fall arresting forces and is also designed to lessen the employee's impact. A shock absorber will reduce the fall forces by 65% to 80% and limit the force to approximately **900 lbs.**

Always keep in mind that the anchorage point must be capable of supporting 5,000 pounds PER WORKER ATTACHED or twice the maximum impact load as determined by a qualified person.

POSITIONING

The second functional category is the personal positioning system, which holds a worker in place while allowing a hands-free work environment. Whenever a worker leans back, the system is activated, making this an active system. The following is an example of a widely used positioning system.

A. **Personal Protective Gear:** Full Body Harness
B. **Connecting Device:** Rebar Chain Assembly
C. **Anchorage/Attachment Point:** Vertical and Horizontal Rods (Connect at intersecting points of vertical and horizontal rebar)

SUSPENSION

The third category is the personal suspension system. These systems are used widely in the window washing, steel erection and painting industries, and are designed to lower and support a worker while allowing a hands-free work environment. The components of this type of system typically include:

A. **Personal Protective Gear:** Boatswain's Chair/Full Body Harness
B. **Connecting Device:** Workline
C. **Anchorage/Attachment Point:** Anchor Bolt/Carabiner

Suspension system components are NOT designed to arrest a free fall. A back-up fall arrest system must be used in conjunction with the personal suspension system. The fall arrest system will only activate should the worker experience a free fall.

RETRIEVAL

The fourth category of the PFAS is commonly used in confined spaces, and is known as a personal retrieval system. Retrieval systems are primarily used when employees are lowered into tanks, manholes, etc., and may require retrieval from above, should an emergency occur. A typical personal retrieval system includes:

A. **Personal Protective Gear:** Full Body Harness
B. **Connecting Device:** Retractable Lifeline/Rescue Unit
C. **Anchorage/Attachment Point:** Tripod With Eyebolt

C. GENERAL FALL PROTECTION RECOMMENDATIONS

The following items are highly recommended to provide maximum protection of workers and ensure compliance with governmental regulations and Company policies. All of our work environments are different, so the following are guidelines.

1. Always wear and attach fall arrest equipment *before* exposure to any fall hazard.

2. Steel cable lifeline devices, including retracting steel lifelines and steel shock-absorbing lanyards, are an alternative for heat producing work such as welding.

3. Only use equipment from a reputable manufacturer of fall arresters (Bacou-Dalloz, MSA, DBI-Sala).

4. Separate, emergency descent devices are recommended on suspended scaffolds and tower cranes.

5. All fall arrest systems must have a separate emergency rescue procedure in place in the case of an accidental fall from an elevation.

6. All positioning and fall arrest equipment must be inspected daily. Body supports, lanyards, grabs, and lifelines should be discarded when signs of wear appear. Contaminants, such as oversprayed chemicals, acids, concrete, paints, and severe heat and cold should be considered carefully before equipment is chosen.

7. All fall protection equipment should be inspected prior to its first use and every use thereafter.

8. All employees using fall protection must be trained in the proper use, maintenance and care of the equipment prior to being assigned work at heights.

9. Minimizing the time between a fall occurrence and medical attention of the employee is vitally important. A thorough rescue program should be established prior to using any fall protection equipment or system. Provisions must be made for a prompt rescue (within 15 minutes) should a fall occur. Rescue procedures should be reviewed on a regular basis as part of the project's overall safety training and hazard analysis reviews.

10. Always read instructions and warnings contained on and in the product packaging before using any fall protection equipment. Copies of instructions and warnings must be on site and used for training.

11. When using a full body harness, connecting devices should be attached directly to the D-ring located on the back side of the harness, which should be positioned between the shoulder blades.

12. Always keep free-fall distance to 6 feet or less. Always try to attach to an anchor point at or above the level of the back D-ring.

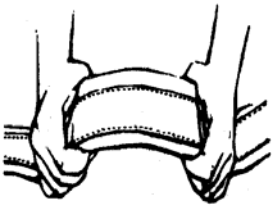
13. Always calculate fall clearances *prior* to starting work to ensure employees attach to an anchor high enough to ensure that no lower level is struck if in the event of a fall from an elevation.

INSPECTION AND MAINTENANCE

To maintain their service life and ensure performance capabilities, fall protection systems must be inspected before and after each use. Regular inspection for wear, damage or corrosion should be part of the project safety plan. Inspect your equipment daily and replace it if any of the defective conditions are found.

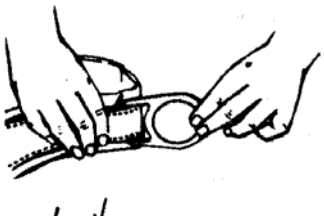
A. FULL BODY HARNESSES

1. BELTS AND HARNESSES

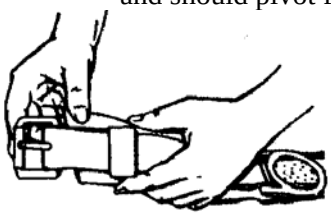


BELTS: Beginning at one end, holding the body side of the belt toward you, grasp the belt with your hands 6 to 8 inches apart. Bend the belt in an inverted "U." The resulting surface tension makes damaged fibers or cuts easier to see. Follow this procedure the entire length of the belt. Watch for frayed edges, broken fibers, pulled stitches, cuts or chemical damage.

HARNESSES: Starting at the top of the harness (hold harness by back D-ring), grasp on strap and run your hand along the entire length. While running your hand along the strap bend the webbing over your index fingers. The resulting surface tension makes damaged fibers or cuts easier to see. Follow this same procedure for all shoulder straps, back straps, leg straps and chest and butt straps. Watch for frayed edges, broken fibers, pulled stitches, cuts or chemical damage.



a. Check D-rings: Check D-rings and their metal or plastic wear pads (if any), for distortion, cracks, breaks, and rough or sharp edges. The D-ring bar should be 90^{o} angle with the long axis of the belt and should pivot freely.

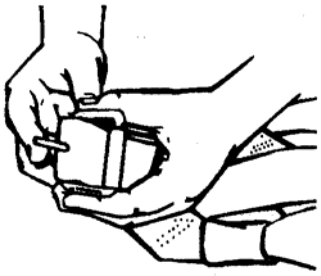


b. Attachments of buckles: Attachment of buckles and D-rings should be given special attention. Note any unusual wear, frayed or cut fibers, or distortion of the buckles or D-rings. Rivets should be tight and unmovable with fingers. Body side rivet base and outside rivet burr should be flat against the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

c. Inspect for Frayed or Broken Strands: Broken webbing strands generally appear as tufts in the webbing surface. Any broken, cut or burned stitches will be readily seen.

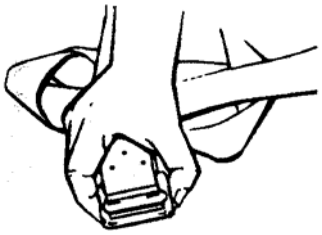
d. The Tongue or Billet: The tongue or billet of a belt or strap receives heavy wear from repeated buckling and unbuckling. Inspect for loose, distorted or broken grommets. Belts and straps should NOT have additional, punched holes.

2. TONGUE BUCKLES



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. The roller should turn freely on the frame. Check the roller for distortion or sharp edges.

3. FRICTION AND MATING BUCKLES

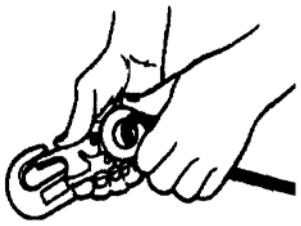


Inspect the buckle for distortion. The outer bars and center bars must be straight. Pay special attention to corners and attachment points of the center bar. Look for burrs and cracks.

B. LANYARD INSPECTIONS

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, i.e., snaps, D-rings and thimbles, should be examined under the following procedures.

1. HARDWARE

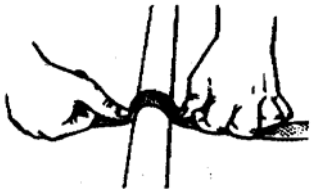


a. **Snaps:** Visually inspect the hook and eye for distortions, cracks, corrosion, or pitted surfaces. The keeper (latch) should seat into the nose without binding and should not be distorted or obstructed. The keeper spring should exert sufficient force to firmly close the keeper. Keeper locks must prevent the keeper from opening when the keeper lock is not depressed.

2. STEEL LANYARD

While rotating the steel lanyard watch for cuts, frayed areas, or unusual wearing patterns on the wire. Broken strands will separate from the body of the lanyard. With a gloved hand, slide a piece of cotton swabbing along the length of the lanyard. Cotton tufts will indicate the presence of broken wire strands.

3. WEB LANYARD



While bending the webbing over a pipe or mandrel, observe each side of the webbed lanyard. This will reveal any cuts or breaks. Examine the web for swelling, discoloration, cracks, and charring. These are signs of chemical or heat damage. Observe closely for any breaks in the stitching.

4. SHOCK-ABSORBING LANYARDS

Shock-absorbing lanyards should be examined using the same method used for web lanyards. However, also look for the warning flag or signs of deployment from the shock-absorbing pack. If the flag has been activated, remove the shock-absorbing lanyard from service immediately.

VISUAL INDICATIONS OF DAMAGE TO WEBBING AND LANYARDS

TYPE OF WEBBING	HEAT	CHEMICAL	MOLTEN METAL OR FLAME	PAINT & SOLVENTS
Nylon and Cordura	In excessive heat, nylon becomes brittle and has a shriveled brownish appearance. Fibers will break when flexed.	Change in color usually appearing as a brownish smear or smudge. Transverse cracks when belt is bent over a mandrel. Loss of elasticity.	Webbing strands fuse together. Hard shiny spots. Hard and brittle to the touch.	Paint which penetrates and dries restricts movement of fibers. Drying agents and solvents in some paints will appear as chemical damage.
Polyester (Dacron*)	Same as nylon, except DO NOT use above 200^0 F.	Same as nylon.	Same as nylon.	Same as nylon.

*NOTE: *Du Pont trademark*

C. CLEANING, MAINTENANCE AND STORAGE

Basic care of all safety equipment will prolong the durable life of the unit and will contribute toward the performance of its vital safety function. Proper storage and maintenance after use are as important as cleaning the equipment of dirt, corrosives, or contaminants. Storage areas should be clean, dry and free of exposure to fumes or corrosive elements.

1. NYLON & POLYESTER

For removing loose debris from PFAS equipment, washing in soapy water works best. After washing, rinse the equipment with fresh water. DO NOT DRY-CLEAN OR USE INDUSTRIAL SOLVENTS ON SYNTHETIC MATERIALS! These can degrade the material by leaching out oils used in the manufacturing process, which provide strength to the material.

Wipe off all surface dirt with a sponge dampened in plain water. Squeeze the sponge dry. Dip the sponge in a mild solution of water and commercial soap or detergent. Work up a lather with a vigorous back and forth motion. Then wipe the equipment dry with a clean cloth. Hang freely to air dry. Keep away from excessive heat or direct sunlight.

2. DRYING

Belts and other equipment should be allowed to dry thoroughly in a cool area away from heat sources, steam and UV light.

3. STORAGE

The equipment should be stored and hung freely by the back D-ring in a cool dry place until needed. If materials appear to be faded, or tags and labels are illegible, consult the equipment manufacturer to determine if replacement is necessary.

D. FULL BODY HARNESS DONNING PROCEDURES

All full body harnesses should be visually inspected before each use. After inspecting the harness, follow the donning procedures below.

Donning Procedures:

1. Grasp harness by the back D-ring and shake the unit to allow all straps to fall in place.

2. If waist and/or leg straps are buckled, release straps and unbuckle at this time.

3. As if donning a vest, slip straps over shoulders so D-ring is located in the middle of back.

4. If the harness is equipped with a waist strap, connect the waist strap. The strap should be tight, but not binding.

5. Pull buckle portion of leg strap between the legs and connect it to opposite end of leg strap. Repeat this process with the second leg strap.

6. After all straps have been connected, tighten all buckles so that the harness fits snug but allows a full range of movement.

7. If the harness contains a chest strap, pull the chest strap around the shoulder strap and fasten it in the mid chest area. Tighten chest strap to keep shoulder straps in place.

8. When not in use, the harness should be stored hanging by the back D-ring. This will assist in the unit retaining its original shape.

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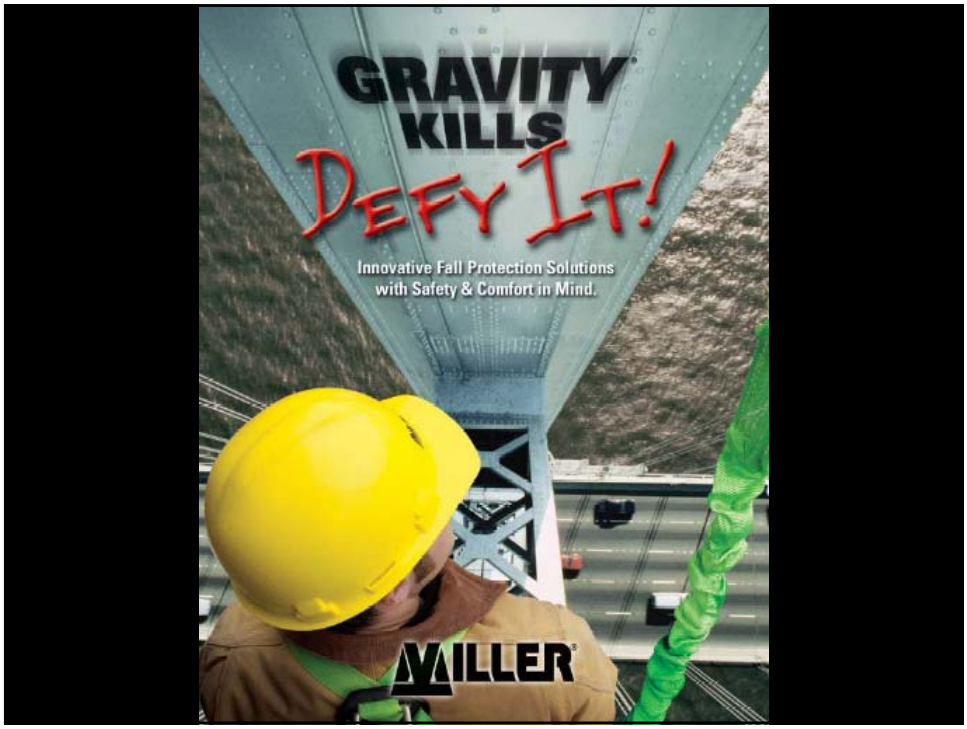


Subpart M
Fall Prevention & Protection

- Addresses the 3 Parts of a fall arrest system;
  - A: Anchorage
  - B: Body Wear
  - C: Connector (Lanyard, YoYo)

  Discussed equipment evaluation, inspection and record keeping

Subpart M Con't

- How to evaluate fall distance and forces applied during a fall
- How to properly set up a horizontal life line system.
- Causes of falls
- Fall Prevention plan

Falls in Construction

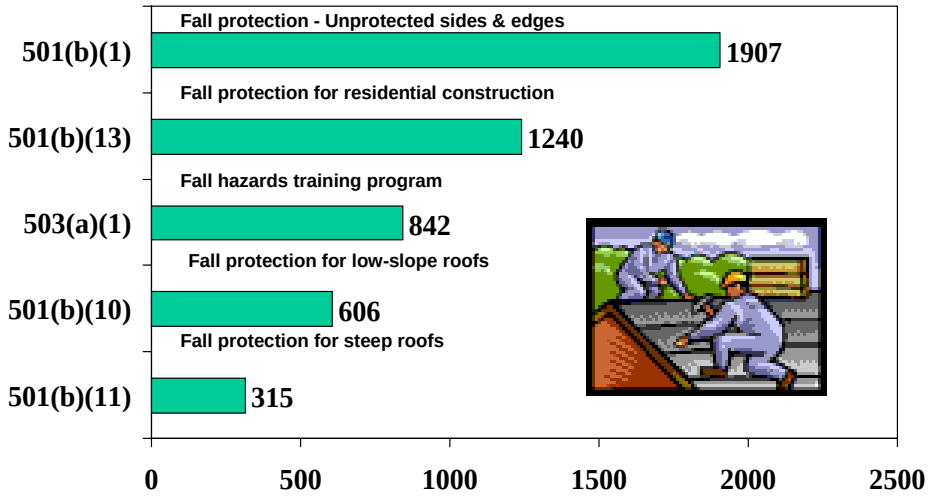
Falls are the leading cause of deaths in the construction industry.

Most fatalities occur when employees fall from open-sided floors and through floor openings.

Falls from as little as 4 to 6 feet can cause serious lost-time accidents and sometimes death.

Open-sided floors and platforms 6 feet or more in

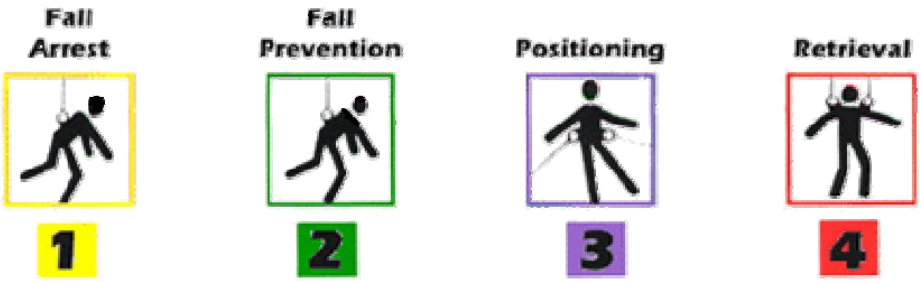
2003 Subpart M 1926.500-503 Fall Protection



What Is Fall Protection?

- **A series of reasonable steps taken to cause elimination or control of the injurious effects of an unintentional fall while accessing or working at height**

The Steps of Fall Protection?



- **Is this the correct order?**

Controlling Fall Exposures

- Select fall protection systems appropriate for given situations.
- Use proper construction and installation of safety systems.
- Supervise employees properly.
- Use safe work procedures.
- Train workers in the proper selection, use, and maintenance of fall protection systems.

Fall Protection Plan

- Prepared by qualified person
- Specific to site
- Changes made by qualified person
- Plan kept at site

Fall Protection Plan

- Implemented by competent person
- Documents why conventional fall protection is infeasible
- Discuss measures used to protect workers

Training

- For each employee who might be exposed to falls
- Trained by competent person
- Covers fall hazards in work area
- Covers procedures for FPS to be used

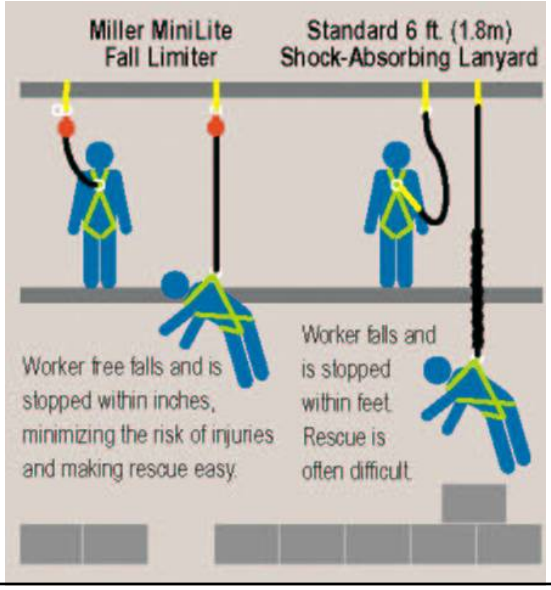
Training

- The use and operation of guardrail systems, personal fall arrest systems, safety net systems, warning line systems, safety monitoring systems, and other protection to be used;

Certification

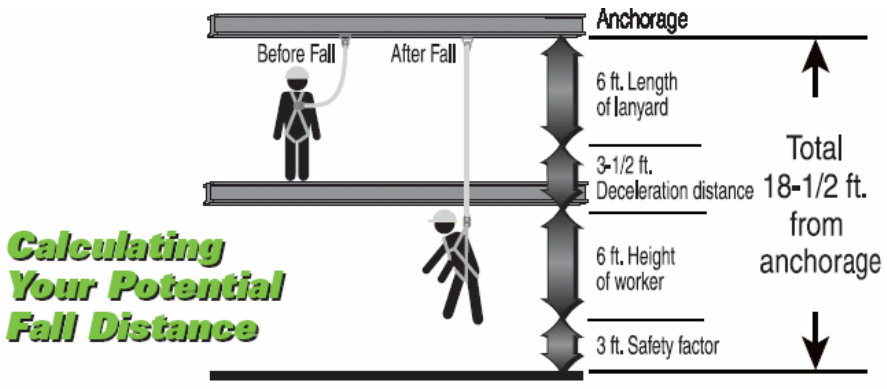
- Training must be certified
- Latest training certification maintained and available!

Minimizing Free Fall Distance



Calculating Total Fall Clearance Distance

Shock-absorbing lanyards extend deceleration distance during a fall, significantly reducing fall arrest forces by 65 to 80 percent below the threshold of injury. This ensures greater safety on the jobsite. However, when using a shock-absorbing lanyard, it is important to understand how to calculate potential fall distance to avoid contact with a lower level.



Example 1: The following is based on a 220 pound man, free falling 6 feet into a nylon rope lanyard. We must first calculate the velocity. This is done using the above equation, factoring in our 6 foot free fall and the pull of gravity.

Velocity = $\sqrt{(2)(32.2\ ft/s^2)(6\ ft)} = 19.65 ft/s$

Now, utilizing our average FAF equation, we calculate the force generated in the above example. For our example, we have estimated the stopping time associated with a 6-foot nylon rope lanyard to be .05 seconds. This estimate is based on actual lab tests.

Average FAF $\cong \frac{(220\ lbs.)(19.65\ ft/s)}{(32.2\ ft/s^2)(.05s)} = 2{,}685$ pounds

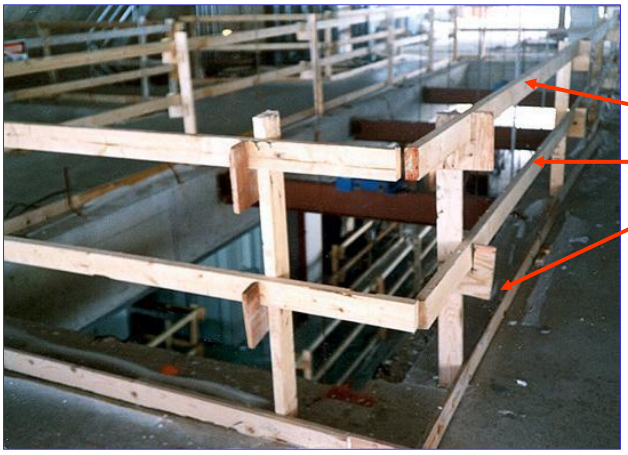
The average fall arresting force in this example is 2,685 pounds (which exceeds OSHA's allowable Maximum Arresting Force of 1,800 pounds).

*** This is why Kiewit does NOT allow rope lanyards.**

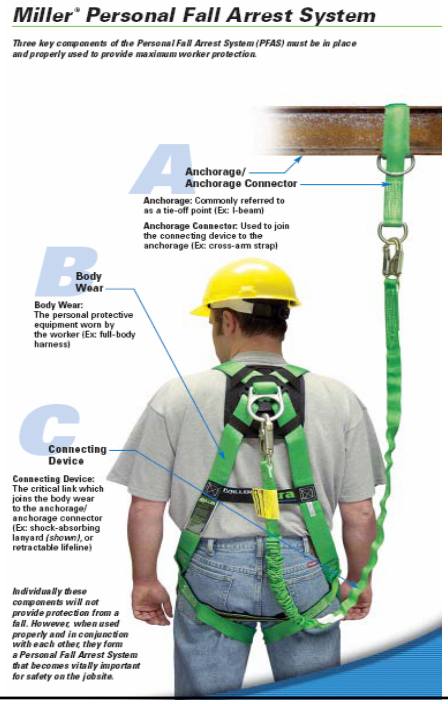
Guardrails

- Primary Issues
  - Complete System
    - Full coverage
    - Accessways/Ladderways
    - Material Handling Areas
  - Proper construction
    - Strength
    - Deflection
  - Maintenance
  - Custody & Control

Guardrails



- **Top rails between 42 inches tall (+/- 3 inches)**
- **Toeboards at least 4 inches high**



Personal Fall Arrest Systems

- Anchorage
- Body
- Connector

Lanyards

Harnesses

Carabineers

Beam Wraps

Rope Grabs

Positioning

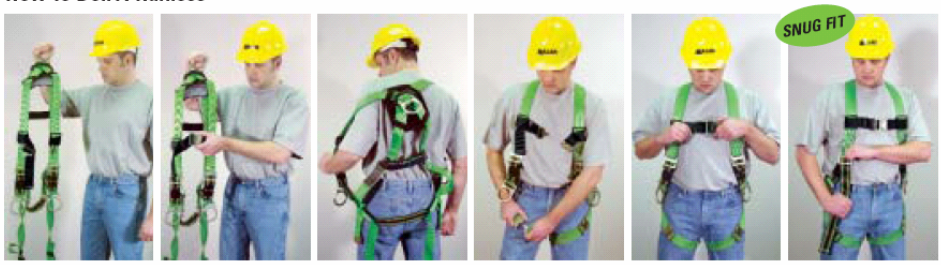
Body (Harnesses)

- Need to be inspected frequently (daily before use by the worker, at least monthly by a Competent Person)
- Should never be modified
- Should be taken out of service immediately if defective or exposed to an impact

through the keeper.

6 Easy Steps That Could Save Your Life

How To Don A Harness



Step 1
Hold harness by back D-ring. Shake harness to allow straps to fall in place.

Step 2
If chest, leg and/or waist straps are buckled, release straps and unbuckle at this time.

Step 3
Slip straps over shoulders so **D-ring is located in middle of back between shoulder blades.**

Step 4
Pull leg straps between legs and connect to opposite end. Repeat with second leg strap. If belted harness, connect waist strap after leg straps.

Step 5
Connect chest strap and position in midchest area. Tighten to keep shoulder straps taut.

Step 6
After all straps have been buckled, **tighten all buckles so that harness fits snug but allows full range of movement.** Pass excess strap through loop keepers.

Adjustment Buckle Types

Friction Buckle
To adjust the friction buckle, simply pass the webbing over the knurled bar and back down between the knurled bar and frame. Pull web end to tighten.

Mating Buckle
To connect the mating buckle, push the center bar buckle completely through the square link and allow it to fall into place. Pull web end to tighten.

Tongue Buckle
The tongue buckle works similar to a belt buckle. Insert the loose strap of webbing through the tongue buckle placing the buckle tongue through the appropriate grommet hole. Push remaining webbing through the keeper.

Quick-Connect Buckle
Quick-Connect Buckles for chest and leg straps interlock similar to a seat belt for easy donning and feature a dual-tab release mechanism to prevent accidental opening.

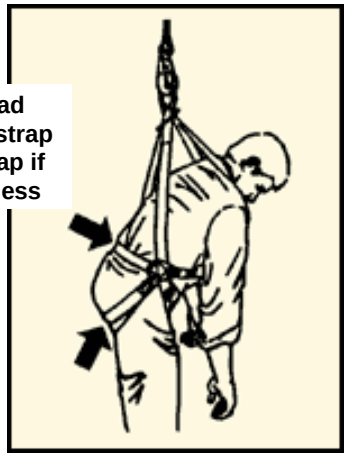
Proper Adjustment Is Key

“Rules of Thumb”

- Be able to reach your D-ring with your thumb
- Maximum Four (flat) Fingers of Slack at the legs, straps as high as comfortably possible
- Ensure chest strap is across the chest/breastbone
- Have a buddy double check for twists, etc…

Harness Pressure Points

Spread load across butt strap and belt strap if on the harness

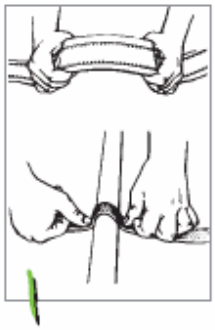


Excess pressure here can cut blood flow to the legs

Some studies have indicated permanent damage to the lower extremities when the worker hangs for more than fifteen (15) minutes.

Harness (and Body Belt) Inspection

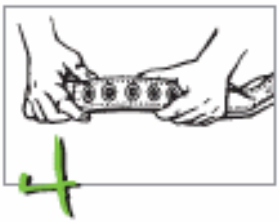
To inspect your harness or body belt, perform the following procedures.



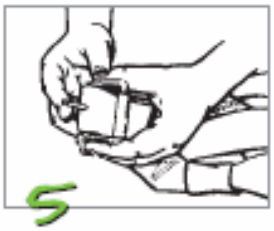
1) Webbing – Grasp the webbing with your hands 6 inches *(152mm)* to 8 inches *(203mm)* apart. Bend the webbing in an inverted "U" as shown. The surface tension resulting makes damaged fibers or cuts easier to detect. Follow this procedure the entire length of the webbing, inspecting both sides of each strap. Look for frayed edges, broken fibers, pulled stitches, cuts, burns and chemical damage.

2) D-Rings/Back Pads – Check D-rings for distortion, cracks, breaks, and rough or sharp edges. The D-ring should pivot freely. D-ring back pads should also be inspected for damage.

3) Attachment of Buckles – Inspect for any unusual wear, frayed or cut fibers, or broken stitching of the buckle or D-ring attachments.



4) Tongue/Grommets – The tongue receives heavy wear from repeated buckling and unbuckling. Inspect for loose, distorted or broken grommets. Webbing should not have additional punched holes.



5) Tongue Buckles – 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. Roller should turn freely on frame. Check for distortion or sharp edges.

6) Friction and Mating Buckles – Inspect the buckle for distortion. The outer bars and center bars must be straight. Pay special attention to corners and attachment points at the center bar.

1) Hardware –

a. Snaps: Inspect closely for hook and eye distortions, cracks, corrosion, or pitted surfaces. The keeper (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 locks must prevent the keeper from opening when the keeper closes.

Inspection and Maintenance of a Personal Fall Arrest System *(continued)*

Cleaning

Basic care of all safety equipment will prolong the durable life of the unit and will contribute toward the performance of its vital safety function. Proper storage and maintenance after use are as important as cleansing the equipment of dirt, corrosives or contaminants. Storage areas should be clean, dry and free of exposure to fumes or corrosive elements.

1) Nylon or Polyester – Remove all surface dirt with a sponge dampened in plain water. Squeeze the sponge dry. Dip the sponge in a mild solution of water and commercial soap or detergent. Work up a thick lather with a vigorous back and forth motion; then wipe with a clean cloth. Hang freely to dry, but away from excessive heat.

2) Drying – Equipment should dry thoroughly without close exposure to heat, steam or long periods of sunlight.

Positioning Systems

- Positioning Devices Provide Hands-free Work
  - Additional Fall Protection (tie-off) is required to move or access
- Positioning Devices are NOT a fall prevention/arrest system.

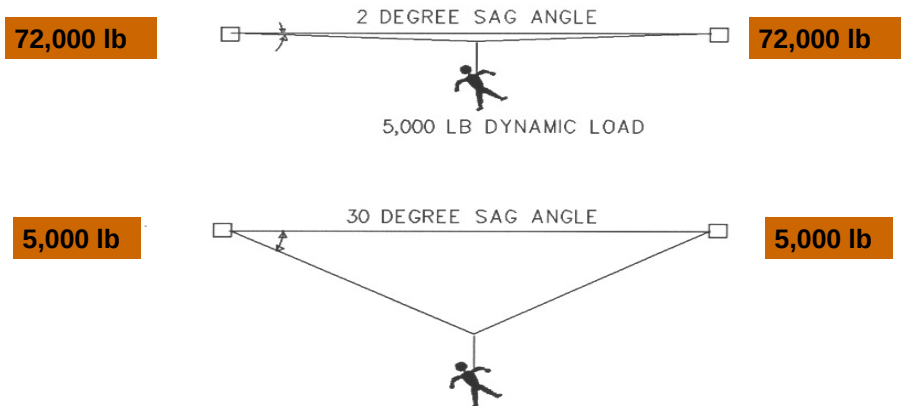
Do Not Hook Lanyards to Retractables!

- This worker is hooked to a retractable lifeline with his lanyard.
- This can cause hook failures and affect the locking capability of the retractable.
- The retractable should be attached directly to the "D" ring.

Watch Swing Falls

- This worker is tied off using a retractable lifeline.
- There is a major swing fall potential if he fell to either side.

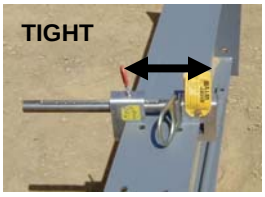
Horizontal Line Engineering

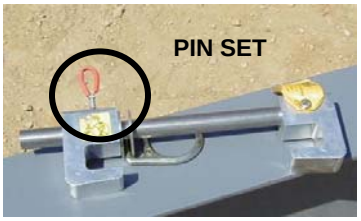


Anchor stress depends on the sag angle of the line.

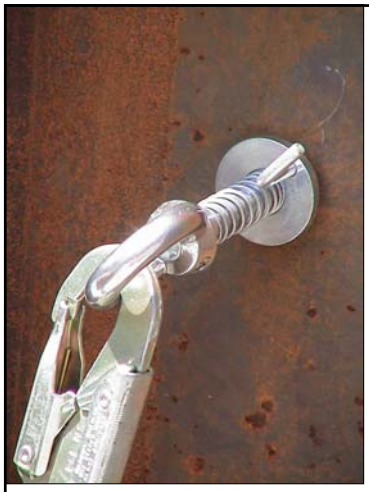
Beam Clamps

Beam clamps can make an effective anchorage when used properly, and with the correct lanyard





Be sure pin is inserted full length and clamp is tight.



Girder Grip Anchorage Rings

- These attachments can be mounted through bolt holes on steel members.
- They are rated at 5,000 lbs. in all directions

Pre-Issuance Inspection Log for
Fall Arrest Systems or Components

Item	Model	Model Number	Manufacturer	Serial Number	Date of Manufacturer	Date in Service (*)	General Appearance	Date Inspected	Inspected By
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									

(*) All equipment must be destroyed after a maximum of 5 years in service.

FALL PROTECTION PROGRAM SELF-ASSESSMENT CHECKLIST

Yes	No	PLANNING
❍	❍	1. Is there a written fall protection plan available?
❍	❍	2. Is there a designated fall protection competent person?
❍	❍	3. Have safe methods to retrieve fallen workers been planned and documented?
❍	❍	4. Do work methods maximize the use of primary fall protection systems such as standard guardrail systems, scaffolding, elevated work platforms, etc. where feasible?

Yes	No	GUARDRAIL SYSTEMS
❍	❍	1. Do guardrail systems meet height and strength requirements? Top rail = 42 inches +/- 3 inches (California = 42 inches + 3 inches) Mid rail = midway between top rail and walking / working surface Withstand 200 lbs applied in outward direction along top edge Top rail cannot deflect downwards to a height less than 39 inches (California = 42 inches)
❍	❍	2. Are guardrail systems surfaced smoothly to prevent puncture, laceration, or snagging hazards?
❍	❍	3. Are top rails and mid rails terminated so as not to overhang terminal posts and present a projection hazard?
❍	❍	4. If wire rope is used for top rail, is it at least 3/8-inch diameter? Is it flagged at 6 foot intervals with high-visibility material?

Yes	No	ANCHORAGE POINTS
❍	❍	1. Do workers know appropriate anchorage points for each task that requires a fall-arrest or restraint system?
❍	❍	2. Are all anchorage points stable, substantial, and have sufficient strength to withstand 5,000 lbs OR twice the potential impact energy of the free-fall?

Yes	No	ANCHORAGE POINTS (continued)
❍	❍	3. Are all anchorage points for body harnesses located at shoulder height?
❍	❍	4. Are anchorage points for self-retracting lifeline systems located overhead?
❍	❍	5. Are connections to anchorage points appropriate (i.e. softeners are used around sharp edges)?

Yes	No	VERTICAL LIFELINES
❍	❍	1. Does the lifeline have a minimum breaking strength of 5,000 pounds?
❍	❍	2. Is the lifeline protected from abrasive or cutting edges?
❍	❍	3. Does the system provide fall protection as the worker connects to and releases from the lifeline?
❍	❍	4. Is the lifeline arranged so workers never have to hold it for balance? (A lifeline should never be used for balance.)
❍	❍	5. Is the vertical segment integrated with the horizontal segment to provide continuous fall protection?
❍	❍	6. Can a worker move from one station to another or climb up and down without exposure to a fall?

Yes	No	HORIZONTAL LIFELINES
❍	❍	1. Has the entire horizontal lifeline system been designated and approved by a qualified person?
❍	❍	2. Have the anchorages to which the lifeline is attached been designed and evaluated specifically for a horizontal lifeline?
❍	❍	3. Has the designer of the system approved the number of workers who will be using it?
❍	❍	4. Is the rope or cable free from signs of wear or abrasion?
❍	❍	5. Does the rope or cable have the required sag as determined in the engineers horizontal lifeline design specifications?
❍	❍	6. Have the workers been warned about potential falls?
❍	❍	7. Have the clearances been checked?

Yes	No	HORIZONTAL LIFELINES (continued)
❍	❍	8. Is the hardware riding on the horizontal lifeline made of steel? (Aluminum is not permitted because it wears excessively.)

Yes	No	LANYARDS
❍	❍	1. Is the lanyard length as short as necessary and in no case greater than 6 feet (1.8 meters)?
❍	❍	2. Does the lanyard have a shock-absorbing feature?
❍	❍	3. If the lanyard has a shock absorber, does the user know how to recognize that the shock absorber has been deployed (warning label, broken pouch, etc.)?
❍	❍	4. Have you prohibited tying knots in the lanyard?
❍	❍	5. Are positioning lanyards connected to anchorages capable of holding at least 3,000 lbs?

Yes	No	SELF RETRACTABLE LIFELINE (SRL)
❍	❍	1. Are workers properly trained to use and inspect the SRL prior to use?
❍	❍	2. Is the SRL under a regular maintenance and inspection program?
❍	❍	3. Are users familiar with the warning device indicating the SRL has been shock loaded?
❍	❍	4. Are SRL's installed in such a way that they are not side loaded?
❍	❍	5. Are SRL's set up to prevent abrasive wear on the cable?

Yes	No	SNAP HOOKS
❍	❍	1. Have double-locking snap hooks been used and are they compatible with other components?
❍	❍	2. Is the snap hook attached to the D-ring, eyebolt, or other hardware in a manner approved by the manufacturer of the snap hook?
❍	❍	3. Are snap hooks inspected regularly for stress, wear, distortion, corrosion and spring failure?
❍	❍	4. Are snap hooks arranged so they are never connected to each other? (They should NOT be connected to each other.)

Yes	No	BODY HARNESSES
❍	❍	1. Are full-body harnesses selected for a particular job equipped with all necessary attachment points (for fall arresting, work positioning, descent control, rescue, or ladder fall-protection systems)?
❍	❍	2. Are body harnesses inspected regularly for wear, abrasion, broken stitching, and missing hardware?
❍	❍	3. Have workers been instructed in the fit, use and care of body harnesses and devices?

Yes	No	OTHER CONSIDERATIONS
❍	❍	1. Has the free-fall distance been considered, so that a worker will not strike a lower surface or object before the fall is arrested?
❍	❍	2. Have pendulum-swing fall hazards been eliminated?
❍	❍	3. Is all fall-arrest equipment free of potential damage from welding, chemical corrosion, or abrasive blasts?
❍	❍	4. Are all components of the system compatible according to the manufacture's instruction?
❍	❍	5. Have employees been properly trained in the following issues? Recognizing fall hazards and the nature of fall hazards in the work area. Correct procedures for erecting, maintaining, disassembling and inspecting fall protection systems. Use and operation of all forms of fall protection to be used, including guardrail systems. Manufacturer's recommendations, restrictions, instructions, and warnings. Location of appropriate anchorage points and attachment techniques. Limitations of mechanical fall protection equipment.
❍	❍	6. Are training records / certifications available?
❍	❍	7. Are all regular inspections performed by trained inspectors?
❍	❍	8. Are written reports of inspections maintained?

Fall Protection Audit Form

FALL PROTECTION CHECKLIST | **Date:** | **Project:**

Safe Work Practices	Corrective Measures	YES	NO	N/A
Is there a Written Fall Protection Plan?				
Affected Employees Completed Fall Protection Training?				
Fall Protection Training Documentation?				
Specific Operation Fall Protection Work Plans?				
Written Scaffold/Falsework Program?				
Falsework Work Plan Documentation?				
Is there a list of Specific Fall Hazard Recognition Document?				
Wearning/Maintenance/Storage PFAS Training?				
Equipment Inspection Training?				
Documented List of Fall Protection Competent Persons?				
Documented List of Scaffold/Falsework Competent Persons?				
Written Rescue Program for Fall Protection?				
Documented Inspections of Scaffold/Falsework?				
Fall Protection Engineering Designs or Manufactured?				
Tracking of Fall Protection Equipment?				

FIELD INSPECTIONS Equipment	Corrective Measures	YES	NO	N/A
Have body harnesses been inspected?				
User inspect PFAS before, during and after?				
Are harnesses in serviceable condition?				
Are full body harnesses being worn properly?				
Have lanyards been inspected?				
Are lanyards & shock absorbers serviceable?				
Have retractables been inspected?				
Are retractables being used properly?				
Is the right fall protection equipment being used for the operation?				
Are employees tied off when working over 6'?				
Proper calculations for Fall Distance?				
Are all impalement hazards protected?				
Anchorages and Connectors rated for 5,000 pounds?				

Handrails/Guardrails	Corrective Measures	YES	NO	N/A
Are top rails 42 inches (+/- 3 inches)?				
Are top/mid rails made out of adequate material to withstand required forces?				
Handrails constructed to withstand a 200 pound load?				
If made of wire rope is rope flagged every 6 feet?				
Are posts seated properly and spaced not more than 8 feet on center?				
Are rails in good condition and free of snags or damage?				

Horizontal Lifelines	Corrective Measures	YES	NO	N/A
Has system been designed and is copy of design available for review?				
Is the cable free of any wear, abrasions or debris?				
Has the SPLAT factor been checked?				
Are the anchorages been designed and checked for the lifeline?				
Are the wire rope clamps spaced 3 1/2 inches apart?				

Fall Protection Audit Form

Horizontal Lifelines, Continued	Corrective Measures	YES	NO	N/A
Are the clamps saddled properly and the nuts tightened to 40 pounds or 3-threads?				
Is the lifeline a minimum of 36-inches off the ground?				

Vertical Lifelines	Corrective Measures	Yes	NO	N/A
Has system been designed and is copy of design available for review?				
Is the cable free of any wear, abrasions or debris?				
Are the anchorages been designed and checked for the lifeline?				
Each employee have a separate vertical lifeline?				

Warning Lines	Corrective Measures	YES	NO	N/A
Warning lines erected not less than 6 feet from the work edge?				
When mechanical equipment is used, warning lines erected not less than 10 feet from the work edge?				
Warning lines made of rope or wire flagged at 6 foot intervals?				
Warning line is not less than 34" nor higher than 39" from work surface?				
Stanchions capable of resisting, without tipping, a force of 16 pounds at 30-inches?				
Material used for warning line has a minimum tensile strength of 500-pounds?				
Warning line rigged to tip stanchion in immediate work area (and not after slack)?				

Hole Covers	Corrective Measures	Yes	NO	N/A
Covers in roadways capable of supporting at least 4X the maximum axle load?				
Covers in pedestrian areas capable of supporting at least twice the anticipated load?				
All covers secured to prevent accidental displacement?				
All covers color coded or marked with "HOLE" or "COVER"?				

Stairtower/Scaffolds	Corrective Measures	Yes	NO	N/A
Has the scaffold been put together properly?				
Has the competent person inspected and cleared the scaffold for use?				
Is the scaffold tagged for serviceability?				
Are access areas free of material buildup and debris?				
Is scaffold plumb and level?				
Are handrails in use?				
Are planks properly overlapped and secured?				
Is there a maximum of 14 inches from the face of the scaffold to the wall?				
Are walking working surfaces 18" or wider and secured?				
Are bases or mudsills being used?				
Are scaffold braces and frames in good condition?				

8.0 APPENDIX

8.1 DEFINITIONS AND TERMS

The following fall protection definitions are common terms associated with fall protection as noted from OSHA Standards Subpart M-Fall Protection 1926.500(b) *Definitions* and ANSI Z359.1-1992 (R1999).

Activation Distance – distance traveled by the fall arrester or the amount of line deployed by a self-retracting lifeline (SRL) from the point of onset of the fall to the activation point where the fall arrester begins to apply a braking or stopping force. This activation point may occur where the fall arrester engages the lifeline or, in the case of an SRL, where the internal brake engages.

Anchorage – a secure point of attachment for lifelines, lanyards or deceleration devices. Anchorages used for attachment of personal fall arrest equipment shall be independent of any anchorage being used to support or suspend platforms and capable of supporting at least 5,000 pounds per employee attached, or shall be designed, installed and used in accordance with the requirements.

Authorized Person – a person approved or assigned by the employer to perform a specific type of duty or duties. For the purpose of the Fall Solutions Manual the word user should be considered synonymous with Authorized Person.

Body Belt (Safety Belt) – a strap with means both for securing it about the waist and for attachment to a lanyard or lifeline. A body belt cannot be used for fall arrest.

Body Harness (full) – straps that are secured about a body in a manner that distributes the arresting forces over at least the thighs, waist, chest, shoulders, and pelvis, with provision for attaching a lanyard, lifeline, or deceleration device.

Competent Person – a person capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

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

Controlled Access Zone (CAZ) – an area in which certain work (e.g., overhand bricklaying) may take place without the use of guardrail systems, personal fall arrest systems, or safety net systems and access to the zone is controlled. **(Not authorized for use on Kiewit jobsites.)**

Deceleration Device – any mechanism, such as a rope grab, rip-stitch lanyard, specially-woven lanyard, tearing or deforming lanyards, automatic self-retracting lifelines/lanyards, etc., which serves to dissipate a substantial amount of energy during a fall arrest, or otherwise limit the energy imposed on an employee during fall arrest.

Deceleration Distance – the additional vertical distance a falling employee 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 an employee's 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 employee comes to a full stop.

Elongation – (1) energy absorber – the maximum elongation of the energy absorber when tested to design capacity can be no greater than 42". (2) Dynamic elongation of components – when subjected to a load many materials will undergo plastic deformation. The extent of plastic deformation in lengths of rope (metal or synthetic) will vary based on the properties of the material and must be accounted for in determining total fall distance, when used as a part of a personal fall arrest system. Note that some materials may have elastic properties and could cause a rebound after reaching the point of maximum arresting force.

Free Fall – is the act of falling before a personal fall arrest system begins to apply resistance to arrest the fall.

Free Fall Distance – the vertical displacement of the fall arrest attachment point on the employee's body harness between onset of the fall and just before the system begins to apply force to arrest the fall. 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.

Guardrail System – a barrier erected to prevent employees from falling to lower levels, which includes a handrail, midrail and toeboard.

Hole – a gap or void 2 inches (5.1 cm) or more in its least dimension, in a floor, roof, or other walking/working surface.

Infeasible – means it is impossible to perform the work using a conventional fall protection system (i.e., guardrail system, safety net system, or personal fall arrest system) or that it is technologically impossible to use any one of these systems to provide fall protection. (Note: with the variety of systems widely available, this argument is not accepted.)

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

Leading Edge – the edge of a floor, roof, or formwork for a floor or other walking/working surface (such as a deck) which changes location as additional floor, roof, decking, or formwork sections are placed, formed, or constructed. A leading edge is considered to be an "unprotected side or edge" during periods when it is not actively and continuously under construction.

Lifeline (horizontal/vertical) – a component consisting of a flexible line for connection to an anchorage at one end to hang vertically (vertical lifeline), or for connection to anchorages at both ends to stretch horizontally (horizontal lifeline), and which serves as a means for connecting other components of a personal fall arrest system to the anchorage.

Low-slope Roof – a roof having a slope less than or equal to 4 in 12 (vertical to horizontal).

Opening – a gap or void 30 inches (76 cm) or more high and 18 inches (48 cm) or more wide, in a wall or partition, through which employees can fall to a lower level.

Overhand Bricklaying and Related Work – the process of laying bricks and masonry units such that the surface of the wall to be jointed is on the opposite side of the wall from the mason, requiring the mason to lean over the wall to complete the work. Related work includes mason tending and electrical installation incorporated into the brick or masonry wall during the overhand bricklaying process.

Personal Fall Arrest System (PFAS) – a system used to arrest an employee in a fall from a working level. It consists of an anchorage, connector, and a body harness and may include a lanyard, deceleration device, lifeline, or suitable combinations of these.

Positioning Device System – a body harness system rigged to allow an employee to be supported on an elevated vertical surface, such as a wall; and work with both hands free while leaning, and limits free fall distance to two-feet or less. (Note: Not to be used as fall protection. Secondary protection not primary.)

Qualified Person – a person who, by possession of a recognized degree, certificate, or professional standing, or who has extensive knowledge, training, and experience and has demonstrated his/her ability to solve or resolve problems relating to the subject matter, the work, or the project.

Restraint Line – a line from a fixed anchorage or from between two anchorages to which a worker is secured in order to prevent the worker from walking or falling off a surface to a lower level. This is not a fall arrest system.

Rope/Cable 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 an employee. A rope grab usually employs the principle of inertial locking, cam/level locking, or both.

Safety-Monitoring System – a safety system in which a competent person is responsible for recognizing and warning employees of fall hazards. (Not authorized for use on Kiewit projects.)

Snaphook – a connector comprised of a hook-shaped member with a normally closed keeper, or similar arrangement, which may be opened to permit the hook to receive an object and, when released, automatically closes to retain the object. Snaphooks are locking type with a self-closing, self-locking keeper which remains closed and locked until unlocked and pressed open for connection or disconnection. [The use of a non-locking snaphook as part of personal fall arrest systems and positioning device systems is prohibited.]

Steep Roof – a roof having a slope greater than 4 in 12 (vertical to horizontal).

Total Fall Distance – the sum of free fall distance and deceleration distance plus any elongation of the system or anchor. This should include lifeline stretch if applicable.

Unprotected Sides and Edges – any side or edge (except at entrances to points of access) of a walking/working surface, e.g., floor, roof, ramp, or runway where there is no wall or guardrail system at least 42 inches (1.0 m) high.

Warning Line System – a barrier erected on a roof to warn employees that they are approaching an unprotected roof side or edge, and which designates an area in which roofing work may take place without the use of guardrail, body harness, or safety net systems to protect employees in the area.

1.0 APPLICATIONS

Section B illustrates several common fall prevention/protection systems used in specific work applications, and should be used as a guide when planning work where employees are potentially exposed to fall hazards. A careful, well-planned analysis should be made to choose the best form of protection (or prevention) consistent with good work practices.

The information contained in this section is provided as a reference. The methods described are those that have been used by superintendents to provide fall prevention/protection for employees engaged in work where the hazard of falling exists. In many cases, different types of prevention/protection may be used in lieu of those described. Consult with your District Safety Manager and Job Sponsor before conducting any work where the hazard of falling exists.

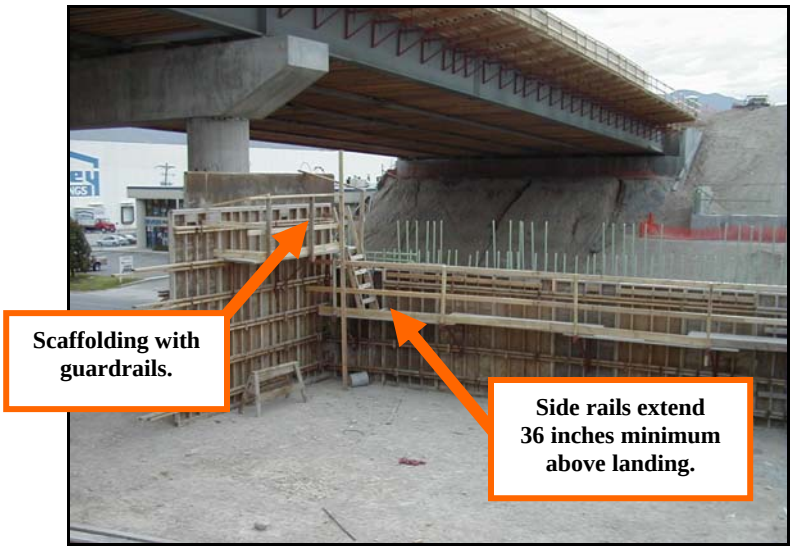
2.0 WALL FORM SYSTEMS

Planning for fall prevention and fall protection on wall form systems shall address the following two areas:

(1) Access to the top of the form to pour and wet finish, and

(2) Access to set, align, bolt-up and strip the forms.

Pour Access



A. Access to the top of the form to pour and wet-finish concrete.

(1) A minimum 20-inch wide scaffold with fully enclosed guardrails and toe boards will be installed at or near the top of one side of the wall form. The outside form shall project high enough (42" to 45" from walkway) to provide a proper guardrail for adequate fall protection. A properly installed ladder will be used to access the work platform.

B. Access to set, align, bolt-up and strip the forms and work must be performed out of an aerial lift, on the form or by ladder.

(1) Use of a 3/8-inch vertical lifeline and LCSD to provide protection during the climb to work areas over 6 feet above the ground. (See "Use of LCSD" for further requirements.) The bottom of the cable is attached to the form, keeping the cable taut.

(2) In addition to using the LCSD as primary protection, a secondary anchorage for positioning should be utilized once in a working position.

(3) If it is necessary to unhook from the LCSD, a system of 100% tie-off procedures is to be followed. Employees shall be instructed to connect to the alternative anchorage point before disconnecting from the LCSD.

3.0 BOTTOM DECK AND LEADING EDGE WORK

Bottom deck placement fall hazards are basically restricted to two areas:

1. The **sides of the deck work**, and
2. The **leading edge under construction.**

A. Fall hazards presented **on the sides** of the deck can be virtually eliminated by keeping the guardrail completed, at least to the point where the rear tie-off cable is attached to the joists.

B. Below is a step-by-step procedure that will be used to place bottom deck:

(1) Equipment Required:

a. Retractable lanyard with a full body harness and SofStop device.

b. Two (2) manufactured anchorage devices (or engineered anchorage points could be used).

(2) Material Required:

a. Two (2) lengths of 3/8-inch cable with 12 cable clamps. (Horizontal Lifelines require Registered Professional Engineer design.)

(3) Procedures:

a. Identify the specific manufacturer (part number) to be installed along with each components load rating.

b. Install first safety cable six (6) feet back from leading edge. Place a 12-inch eye on both ends of the 3/8-inch cable. This eye requires three (3) domestic drop forged fist grips or cable clamps spaced three (3) inches apart.

c. Use this cable as a tie-off to place 8 more feet of bottom deck.

d. Secure the second cable on the anchorage points 6 feet back from the leading edge of the plywood (repeating as in Step 1).

e. Move your tie-off up to that cable while maintaining 100% tie off. As the bottom deck is placed, leap-frog the cable forward.

f. Upon decking the full bridge width for the 16-foot span, bore 1-1/8 inch diameter holes in the joists at the deck's edge and erect the guardrail.

g. At the end of shift, install a warning line at least 6 feet back from the leading edge, or fully guardrail across the leading edge of the bottom deck.

C. Sponsor written approval is required for all foot-level tie-off.

D. Alternatively, for leading edge tie-off work, a manufactured system such as the Miller Edge system may prove to be more versatile and will limit the fall distance as compared to a foot-level tie-off system described above.

Miller "Edge" Fall Protection System for Leading Edge

E. A sign shall be placed at the entrance to the work area and state, **"DANGER – Fall Hazard Area. Fall Arrest Equipment Required Beyond This Point."**

4.0 PLACING BRIDGE OVERHANG FORMS

A. Box Girder Overhangs

Typically, the "horses" supporting the overhang for a box girder bridge are placed from the bottom deck area, which should have a full guardrail, helping to eliminate the fall hazard for this portion of the operation. This is also true during placement of joists and all but the outside row of plywood decking, if the bottom deck width allows. This work may be completed well inside the edge of the guardrail.

The fall hazard presented during placement of the outside sheet of plywood and the overhang guardrail can be mitigated by using a motion-restraint system or a personal fall arrest system.

(1) The procedure for placing the motion restraint is as follows:

a. Attach motion-restraint to an engineered anchorage at the outside stem.

b. Pull cable hand-tight and attach at end of run.

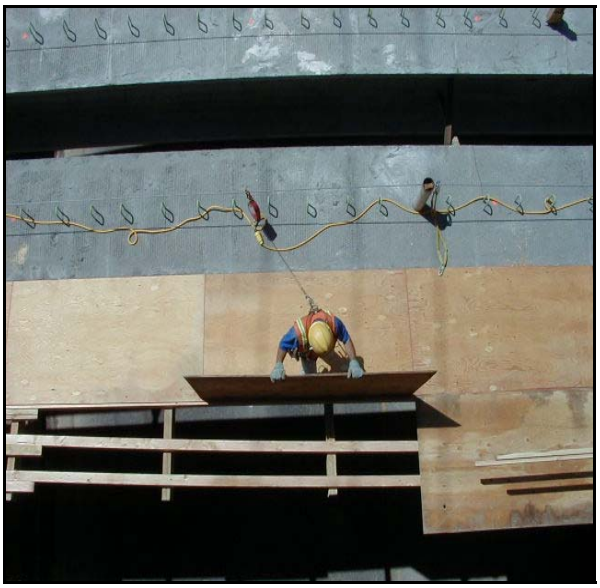
c. Connect to motion restraint.

(2) A sign, at the entrance to the work area, should be installed and state, **"DANGER – Fall Hazard Area. Fall Arrest/Restraint Equipment Required Beyond This Point."**

B. Girder Overhangs

The figure below shows a horizontal lifeline positioned up off the precast girder. The worker is connected to a retractable lanyard. It's important to make sure the retractable is kept perpendicular to the work area to prevent swing related injuries in the event of a fall.

Tie-Off Overhang



5.0 COLUMN FORMS

Access for column work involves four operations requiring fall protection:

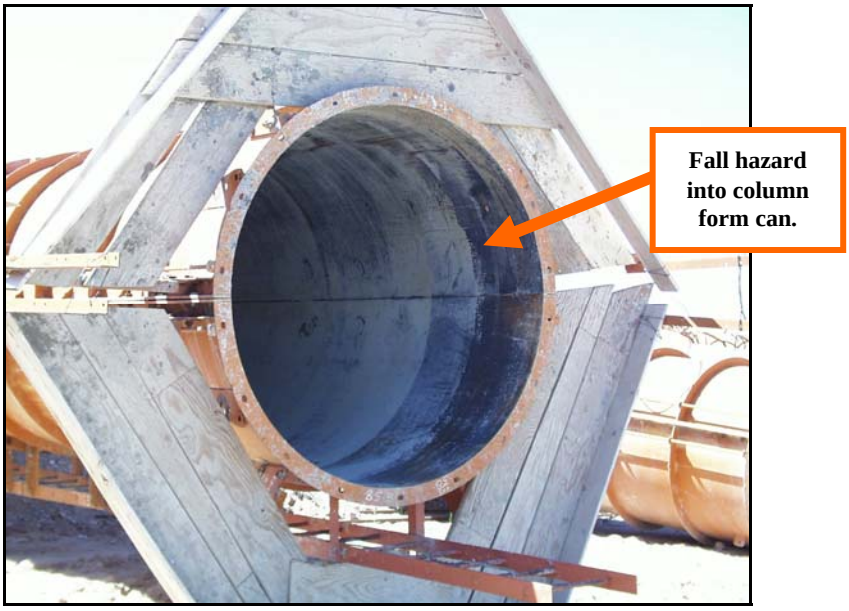
1. Accessing the top of the column form.
2. Working on top of the column form.
3. Working inside the column form.
4. Bolt up and stripping.

A. Access to the top of the column form may be achieved by:

- Using a retractable lanyard secured to an anchorage point; or
- A LCSD secured to a vertical lifeline; or
- If the column can is less than 20 feet in height, a vertical ladder can be used without a personal fall arrest system. Vertical ladders installed greater than 20' will require a fall protection system. Vertical ladders should be attached to the column can in accordance with the manufacturer's requirements.

Access for Column Work

Column Form Access Fall Hazard



NOTE: Verify that this opening is no larger than 6". If the opening is greater than 6", employees will be required to use fall protection equipment. Also, any opening greater than 2" provides the potential for materials to fall to the ground below. Either nets should be installed or the area below is to be completely barricaded to prevent entry.

B. While working on top of column forms, fall prevention and protection will be controlled primarily by the column rebar configuration. "Fixed" columns will typically have a rebar cage that extends above the top of the can and around the full diameter of the column. If this cage extends 42-45 inches above the working platform, it will usually serve as a guardrail, preventing a fall into the form. If the cage does not extend 42-45 inches above the working surface or the rebar cage is "pinned" and permits a fall hazard between the cage and form, additional fall protection may be required. Holes and or openings along the inside of the working, walking surface with a hole greater than 1" should be guarded in order to not have an employee needing to be tied off.

C. While descending the column cage, fall protection may be achieved through the same methods as in ascending the can. A retractable lanyard, LCSD, or vertical ladders may be considered. Column spiral spacing should be considered when evaluating toe holds while descending a column cage.

6.0 HIGH CAPACITY FALSEWORK

Planning for fall prevention and protection on high capacity falsework (600k, 360k and 100k) shall cover:

- Pile driving operations
- Fabrication and erection of towers
- Setting of caps, blocking and stringers
- Falsework stripping

A. Pile Driving Operations

(1) When climbing leads a Ladder Climbing Safety Device (LCSD) shall be used.

(2) Primary and Secondary anchorages will be required once the worker has reached the work location.

(3) If it becomes necessary to unhook from the LCSD to perform work, then a system where primary and secondary (if needed) anchorages will be used.

(4) Do not jump off the leads or tracks of a crane.

B. Fabrication and Erection of Towers

High capacity falsework systems have fall prevention and protection designed as an integral component. The vertical ladder provided with the shoring towers shall be used only after a LCSD is installed.

Each tower section has a 20-inch minimum width platform, four (4) feet from the top of the tower provided for access to the work. A 3/8-inch horizontal lifeline designed by a registered Professional Engineer must be installed and used when working from the platform.

(1) Persons climbing towers and using platforms are required to wear a full body harness with a 2-legged shock-absorbing lanyard and be connected at all times.

(2) Ladder Climbing Safety Devices (LCSD) will be used when climbing towers.

(3) The ladder, scaffold and horizontal/vertical lifelines must be inspected at the start of each shift and maintained free of recognizable defects. Any deficiencies will be corrected immediately.

(4) A plywood cover will be secured in place over the bottom 8 feet of the tower ladder whenever employees are not working in the area to prevent the general public from climbing falsework towers.

C. Setting Caps, Blocking and Stringers

(1) Tie-off on towers per standard procedures.

(2) During the operation of setting stringers, it is often necessary to climb onto the pile cap to unhook the rigging to the stringers. This places the worker in a position of having to anchor the lanyard at or below his/her feet. Therefore, for stringer setting operations, employees shall use a full body harness with a 4-foot shock-absorbing lanyard or retractable lanyard.

D. Falsework Stripping

(1) Winch operations:

a. Winches will be dogged off and padlocked when workers are in or on the falsework.

b. Tie-off on towers as per standard procedures.

c. Workers must be connected to vertical lifelines attached to the bridge with a LCSD or with a retractable lanyard when working on a deck section.

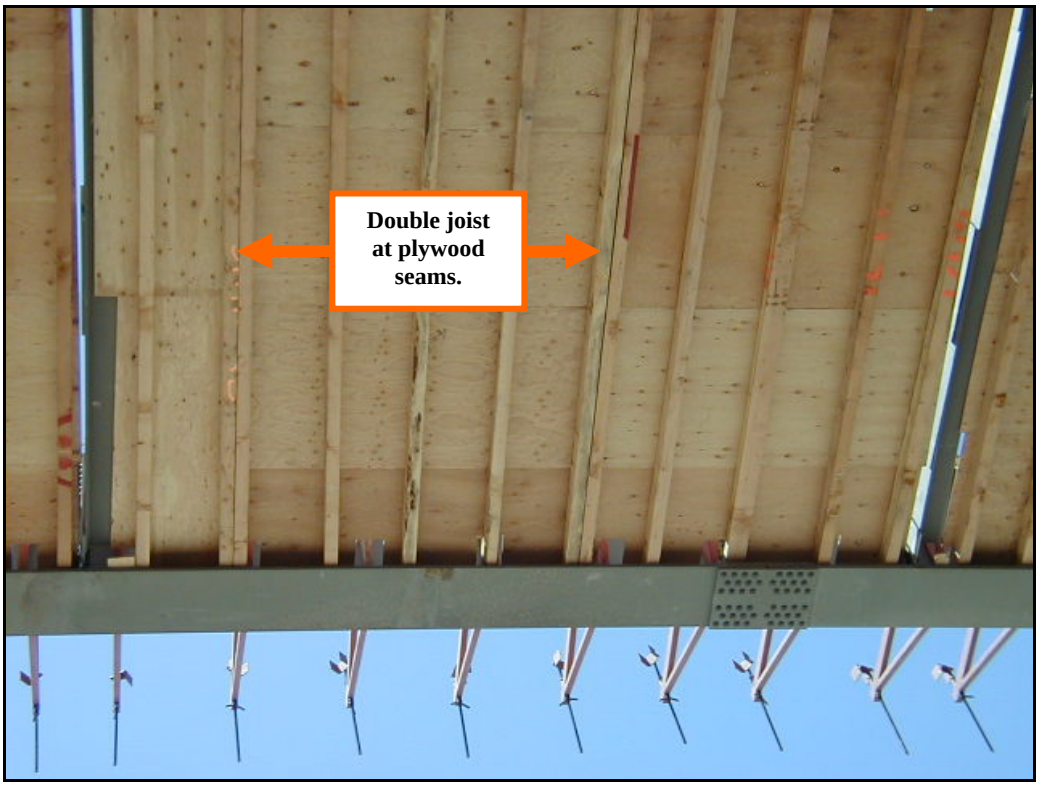
7.0 FALSEDECK

Falsedeck is typically placed on top of the bottom flange of prestressed concrete or structural steel girders to provide safe working access for placing and stripping forms, painting, surveying, etc. The plywood and joist sizing and spacing depend on the distance between girders, and must be analyzed on a case-by-case basis.

A set of standard specifications for falsedecks can be found in the company shoring manuals. Be sure to know the potential loading (light, medium or heavy) taking into consideration materials, personnel and any equipment. Also, know allowable gaps and plywood attachment details.

A horizontal lifeline may be attached to the girder to provide an anchorage during the placing and stripping of the falsedeck. Fall protection equipment, while walking girders is not required after the falsedeck and overhangs are installed, provided that the fall distance is less than 6 feet to the inside of the spans. Fall protection equipment is required during the falsedeck stripping operation, or if there are any openings greater than 6" in the falsedeck.

Falsedeck – Double Joists at Plywood Seams



A. Falsedeck Installation and Removal

The following guidelines are to be used in the preparation of the Fall Protection Plan for this type of operation:

(1) Install horizontal lifelines per company policy.

(2) Connecting to the horizontal lifelines during the installation and removal of the falsedeck is required.

(3) Only the fall protection equipment specified in the Plan may be used.

(4) Connecting is required when working within 6 feet of any opening in the falsedeck and when stripping deck and diaphragm forms.

(5) If the opening between the edge of the falsedeck plywood and the bottom flange of the girder exceeds 6 inches, then lanyard connection will be required for all operations on the falsedeck.

(6) Falsedeck installed over public roads, sidewalks, or railroads requires the plywood to extend to the girder web.

(7) The length of the falsedeck joists shall not be less than the distance between the faces of the girder webs, less two (2) inches.

(8) All plywood must be nailed to each supporting joist with two (2) 8d nails.

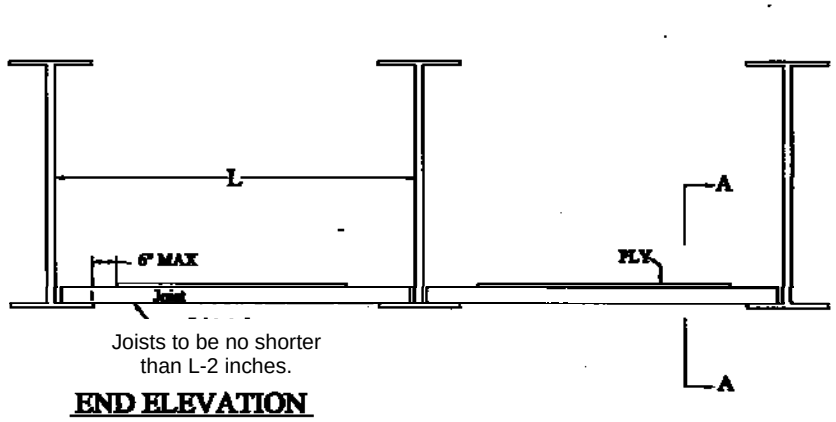
(9) Plywood sheeting shall have independent supports at each end and spacing of joists shall not exceed 32 inches.

(10) A sign, a minimum of 4 feet by 4 feet in size, at the entrance to the work area, needs to be installed and state, **"DANGER – Fall Hazard Area. Fall Protection Required Beyond This Point,"** until the work area is completely covered with falsedeck and provides a fall exposure of less than 6'.

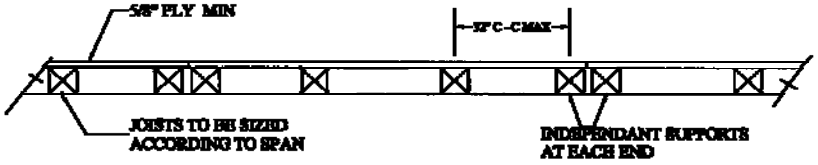
B. Structural Steel Applications

It is preferable to attach the horizontal lifeline while the girder is on the ground. The cable should be placed overhead to minimize free-fall distance. When a horizontal lifeline is installed at 36", a fall of 6 feet may still be possible. If horizontal lifelines can not be installed 36" from the working/walking surface it shall be approved by the designer and the Job Sponsor or other manager as designated by the District Manager.

Structural Steel Applications



END ELEVATION



SECTION A-A

Independent supports are required at each end of the plywood sheet. However, it is acceptable to overlap plywood at the diaphragms. Below is a chart for falsedeck installed in an "access only" configuration.

25 PSF Chart

Joist Spacing Material	6" OC	12" OC	16" OC	18" OC	24" OC
DF #2 4x4	186"	150"	137"	131"	118"
DF #2 4x6	260"	221'	205"	200"	173"
DF #2 4x8	320"	271"	253"	246"	228"
Plywood Direction	Either	Either	Either	Either	Either

C. Prestressed Girder Application

The following is one option for installation of horizontal lifelines for pre-stressed girders.

(1) Horizontal Lifeline Installation and Removal

a. Identify the specific manufacturer (part number) to be installed with each components load rating.

b. One-inch diameter holes need to be cast into the girders on each exterior girder and on alternate interior girders. These holes should be cast two (2) feet from each end of the

girders and one foot six inches (1½ feet) from one side of each interior diaphragm. All holes should be four (4) inches below the bottom of the top flange.

c. Two (2) eyebolts are to be attached with a ¾-inch all-thread rod at each hole at the interior diaphragms.

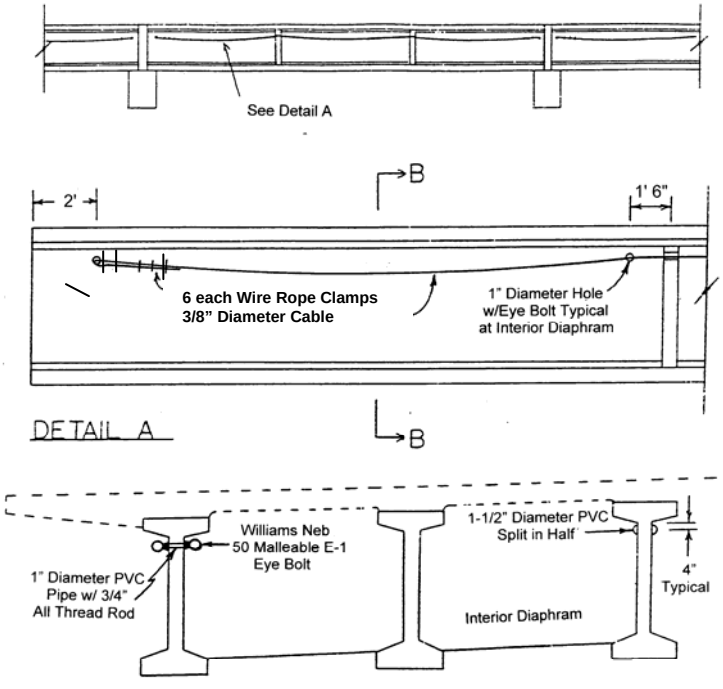
d. A 3/8-inch cable is run through the end holes of the girder and tied back to its self with six (6) 3/8-inch malleable cable clamps or fist grip clamps. (Do not run the cable through the eyebolts, as this will prevent proper removal of the eyebolts.) The cable is to be attached to each of the interior diaphragm eyebolts with a self-locking carabiner rated at 5,000 pounds. When fully installed, the line should have a maximum of one (1) foot of deflection when pulled down at the center of any single span.

e. While forming the interior diaphragms, a piece of 1½-inch PVC pipe split in half is to be placed over the 3/8-inch cable against the girder.

f. Any time after the diaphragms have cured, but prior to stripping the deck formwork, the carabineers are removed, and the eye bolts and all-threads are removed from the interior girders. Do not remove the exterior girder eyebolt as this increases the cable span on the outside of the exterior girder.

g. After all deckwork, falsedeck, and overhangs are stripped and all required dry finish work is complete, the horizontal lifeline is no longer needed. The cable clips can be removed and the horizontal lifeline can be pulled through as a single cable.

Horizontal Lifeline Installation



E-1 EYE BOLTS

FIG 2

PART NO	FIG	INSIDE WIDTH	INSIDE HEIGHT	RING DIA	OVER ALL HT	TAP	STRAIGHT TENSION ULT STRENGTHS
NEB 50 MALLEABLE	FIG 2	3	3	1"	5-3/4"	1/2" -3/4"	26,000

8.0 CROSSBEAMS

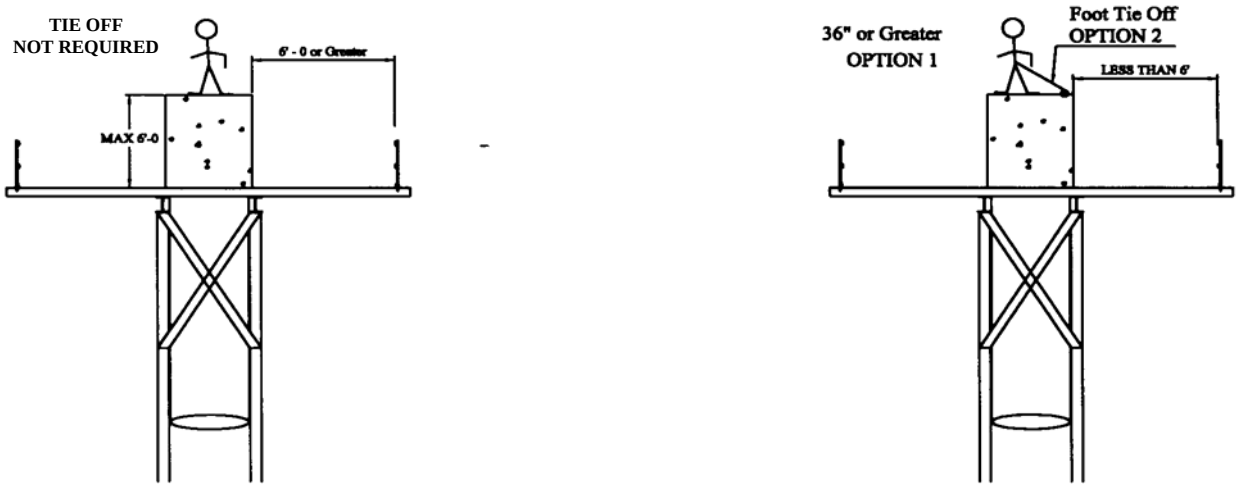
Crossbeam Falsework Stripping Operation

The following sequence of alternatives will be used when selecting methods of fall prevention and protection for working on top of crossbeams.

Walkway access surrounding caps may be separated into two possible scenarios:

A. Deck and guardrail from crossbeam falsework left in place for work on top of the crossbeam.

Falsework Stays in Place for Cap Work



B. Deck and guardrail from crossbeam falsework stripped and moved ahead prior to work on top of the beam.

Deck & Guardrail from Crossbeam Falsework

C. During the planning stage for falsework left in place, the preferred method of fall prevention and protection for work on top of a cap less than 6 feet in height is to construct an access surrounding the cap on the falsework, which provides a 6-foot walkway surrounding the cap, Option A.

(1) The 6-foot walkway will eliminate the circumstances that would allow a fall from the top of the cap over the work deck guardrail, as shown in Option A.

(2) If a 6-foot walkway is not feasible, fall protection must be provided for employees working on top of the cap.

(3) If option B is chosen, a horizontal lifeline of 36 inches or greater in height from the working surface is the preferred option.

(4) When it is not practical or feasible to install a fully guardrailed platform or a horizontal lifeline at 36", a foot-level anchorage may be installed with written approval by the Job Sponsor or other manager as designated by the District Manager.

D. During the planning stage for secondary access, after falsework is stripped, the preferred method of fall protection for work on top of a cap less than 6 feet in height is to construct access surrounding the cap on the second stage access brackets, which provides a 6-foot walkway surrounding the cap.

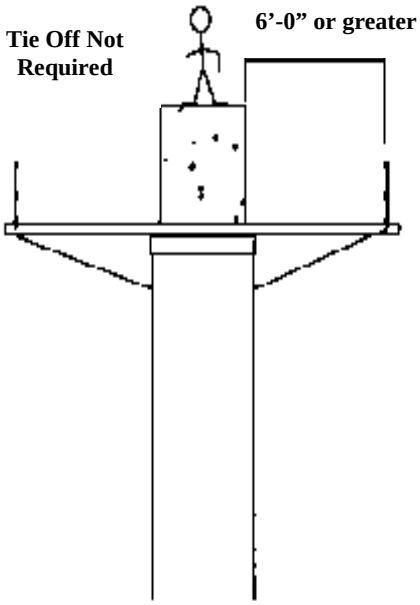
(1) This 6-foot walkway will eliminate the circumstances that could allow a fall to occur from the top of the cap over the work deck guardrail. If a 6-foot walkway is not feasible, fall protection must be provided for employees working on top of the cap, as in Option B.

(2) A horizontal lifeline of 36 inches or greater from the working surface is the preferred option.

(3) When it is not practical or feasible to install wither a fully guardrailed platform or a horizontal lifeline at 36", a foot-level anchorage may be installed with written approval by the Job Sponsor or other manager as designated by the District Manager.

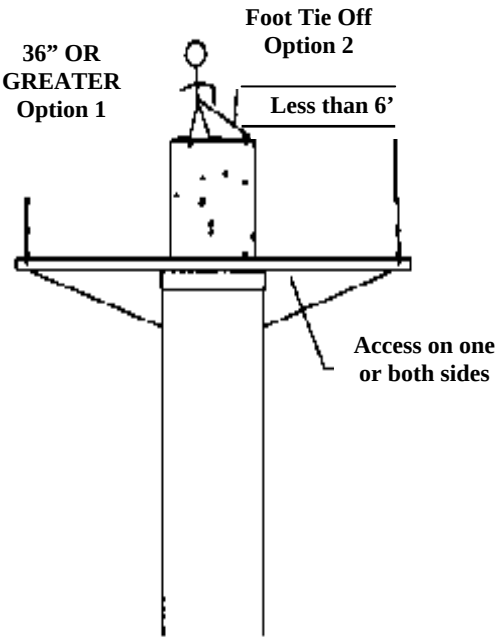
Falsework Stripped and Secondary Access for Cap Work

OPTION A



Horizontal Lifeline installed less than 36" requires Job Sponsor written approval.

OPTION B



9.0 PRECAST AND STEEL GIRDER WORK

Prestressed girder bridgework presents fall hazards associated with each phase of girder installation and deck forming. This section addresses the following:

- Horizontal lifeline procedures:
  - Lifelines affixed to the girder web.
  - Elevated lifelines suspended above girders.
- Prestressed girder erection.
- Placing precast panels.
- Placing and stripping prestressed girder deck formwork.

Precast Girder Cable Anchorage

A. Horizontal Lifelines

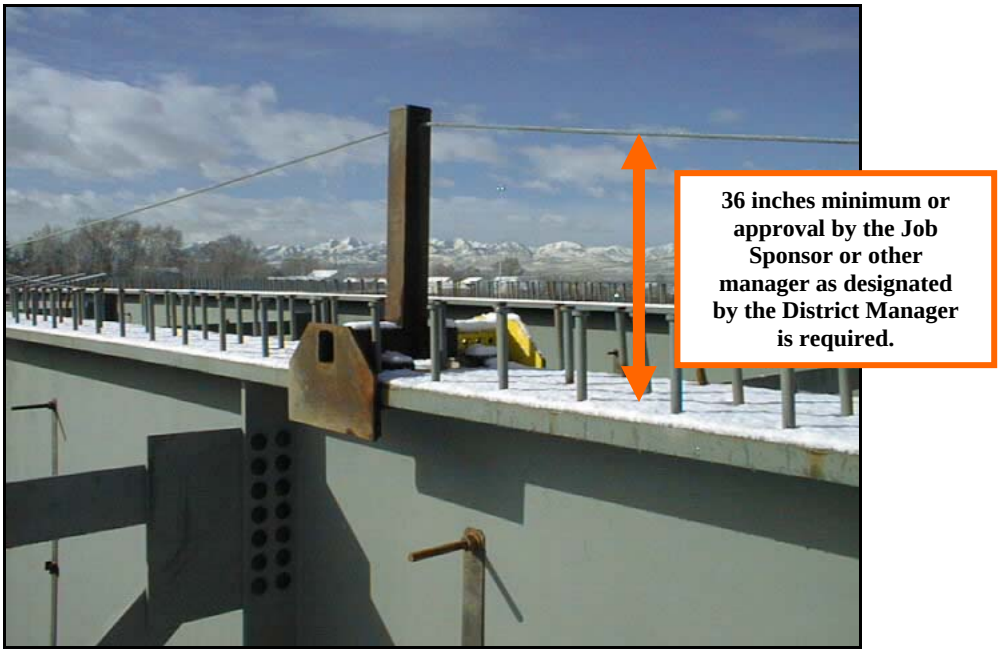
A common denominator in all Fall Protection Plans for precast and steel girder work is the use of a horizontal lifeline attached to the girder. This lifeline is used for:

- Girder erection.
- Falsedeck installation and removal (if falsedeck is used).
- Deck formwork installation.
- Precast panel erection.
- Deck formwork stripping.
- Dry finishing work.

The horizontal lifeline should be attached to the girder web and/or elevated horizontal lifeline installed on the top of the girder. When the horizontal lifeline can not be installed at a height greater than 36", written Job Sponsor approval is required. The lifeline should be installed on the

ground prior to girder erection and should be used for each phase of the work. All elevated lifelines must be an engineered system compatible with the application.

Tie-Off Bracket



B. Erection of Prestressed Girders

Erection of prestressed girders presents fall hazards associated with the following aspects of the operation:

- Preparation work at the crossbeams or falsework.
- Rigging the girder at the transport vehicle.
- Setting girders into position on the crossbeam or falsework.
- Crossbracing, gut wrapping, and installing diaphragm resteel.
- Disconnecting the rigging on the girder.

(1) **Preparation:** Preparation work on the crossbeams or falsework, such as setting bearing pads, grinding seats, installing shims, etc., should be performed within a work area enclosed by a proper scaffold and guardrail system. When the work area cannot be enclosed with a complete guardrail, an engineered horizontal lifeline system should be installed.

When the hazards associated with an elevated lifeline outweigh the benefits, a lifeline installed at foot level may be considered, but requires a Fall Protection Plan and written approval by the Job Sponsor or other manager as designated by the District Manager. Individual lanyard anchorage points may also be utilized in lieu of a lifeline, with a priority on an elevated anchorage.

(2) **Transport Vehicle:** Connecting rigging while the girder is on the transportation vehicle may expose employees to a potential fall greater than 6 feet. Ladders that are sized for the application and secured to the girder prior to performing the connection work are a common method to provide access for this activity.

For heavy rigging, this may require two (2) ladders and additional manpower, or forklift with taglines to help guide the rigging into position. If access to the top surface of the girder is required, a horizontal lifeline or lanyard anchorage point shall be provided.

When girder delivery and staging allows, a lifeline system, as described previously, should be installed prior to rigging the girder and used to provide fall protection for this activity.

(3) **Setting Girders:** Setting the girder into its final location requires workers to be positioned at each end of the girder and at strategic positions to control its movement by taglines. Fall protection for this step shall be the same as outlined in (1) above. At no time while the crane suspends the girder shall employees anchor to it, or stand below it.

(4) **Crossbracing:** During girder setting operations, it may be necessary to access varying points along the girder for such activities such as crossbracing, gut wrapping, and installing diaphragm steel. Access to these areas shall be provided by the use of aerial lifts or scaffolding independent of the girder. Where access along the top of the girder is necessary, the use of an engineered horizontal lifeline is required.

Girder Cross Bracing

(5) **Disconnecting Rigging:** Disconnecting the rigging on the girder presents the same exposure as in (4) above and will require similar protective measures.

C. Placing and Stripping Girder Deck Formwork

Prestressed girder deck formwork presents fall hazards associated with each of the following operations:

- Installing deck formwork.
- Placing, pouring and stripping diaphragms.
- Installing overhang formwork.
- Stripping deck formwork.
- Stripping overhang formwork.
- Dry finishing overhangs.

The primary fall protection measure for prestressed decks is to have the entire deck formed and a perimeter guardrail installed. However, a significant portion of the work in this area includes installing or removing the forms, necessitating fall protection in accordance with this Manual.

Three separate procedures for placing formwork that incorporates fall prevention and protection planning are the:

1. Falsedeck Method.
2. Cart Method – with horizontal lifeline.
3. Elevated Lifeline Method.

(1) Falsedeck Method

a. Falsedeck is installed and removed as described in the "Falsedecks" section of this manual. This system must incorporate the lifeline affixed to the girder web while the falsedeck is installed and removed.

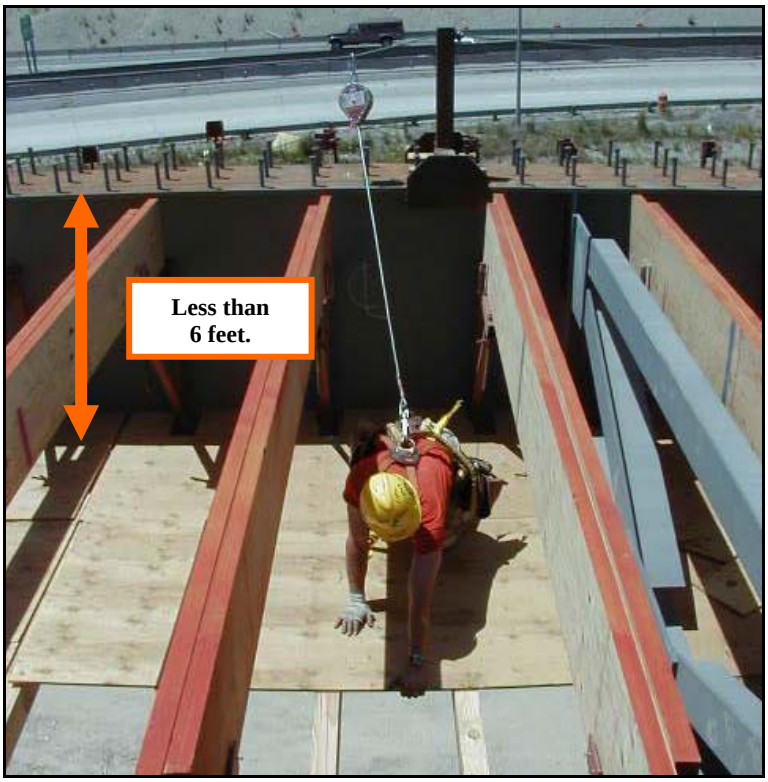
b. Deck formwork is placed and stripped using the falsedeck as a work platform.

c. Overhang brackets are installed with the worker over the side of the girder. Workers will anchor lanyards or retractables with external deceleration device to the horizontal lifeline (the best practice is to install overhang where the interior deck is complete).

d. Overhang decking and guardrail placement will require an additional horizontal lifeline system. An elevated horizontal lifeline or a system similar to that used to place bottom decks, are both permitted options.

e. Overhang formwork should be stripped and overhangs dry finished using an aerial lift, rolling scaffold, or manual method (in order of desirability).

Falsedeck Installation to Eliminate Exposure



(2) Cart Method – With Horizontal Lifeline

a. Horizontal lifelines shall be installed on the girders as described in the falsedecks section of this manual.

b. In this method, deck formwork can be placed with workers on carts, and independently anchored to the horizontal lifeline on the girder. The workers on top of the deck who are within 6 feet of the leading edge of the deck work will use an elevated lifeline or a system similar to that used to place bottom decks.

c. Stripping deck formwork is done with the worker on the cart anchored to a horizontal lifeline.

(3) Elevated Lifeline Method

a. Utilizing an elevated lifeline that is attached to the girders can provide fall protection for installing the overhang formwork and for installing the deck and diaphragms. The lifeline and the supports for the lifeline must be installed as previously described.

b. While the elevated lifeline provides good protection to place formwork, the stripping operation requires different fall protection methods to begin. The falsedeck method, cart method, use of stripping buggies, or aerial lifts are all permitted alternatives.

D. Summary

Girder erection operations present awkward, sometimes difficult access situations that necessitate planning so that each step of the operation can be performed with proper fall protection. If planning of crossbeam work, girder erection and deckwork are integrated, there are opportunities to have a fall prevention and protection system that offers benefits to all operations.

Standardized systems and procedures are difficult to develop for all of the varying situations and configurations of prestressed girder deck work. Job supervision shall provide fall prevention and protection measures for the entire operation where fall exposures exist. Planning with this requirement in mind will allow the numerous steps of prestressed girder deck work to be performed safely and efficiently.

Any work area requiring fall prevention and protection as described above, shall be barricaded or have access restricted by some means so the area is not readily accessible to non-essential or untrained workers. A sign at the entrance to the work area should to be installed and state, **"DANGER – Fall Hazard Area. Fall Arrest Equipment Required Beyond This Point."**

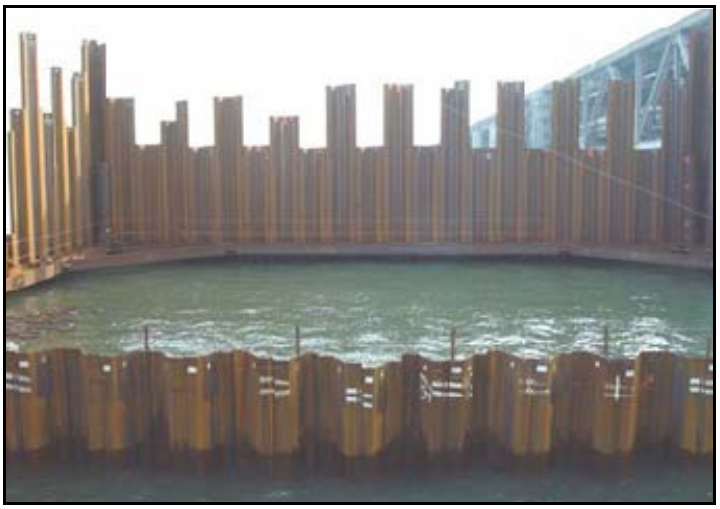
10.0 SHEET PILE AND COFFERDAMS

A. Set cofferdam frames to proper elevation with the top frame above the water or use a separate threading frame.

B. Drive pipe pile studs to achieve good bearing support.

C. Bolt or weld the frames securely to the four (4)-pipe pile studs.

D. Thread (position) the first pair of sheets in the proper location. A drop hammer (hairpin) or vibratory hammer should be used to insert the pair of sheets securely into the soils for support and stability.



E. At this point in time, the single pair of sheets is properly located and partially driven to provide adequate support. The employee will then use a manlift or other means of access, which will eliminate any fall exposure, to assist in threading additional pairs of sheets into the interlocks.

F. Now that the "sheet threading worker" is in position, a second pair of sheets is lofted into position with a crane. (Assure that the employee is never "under" the suspended sheets.)

G. It is important that a procedure is established to verify that the wall of sheets is stable during the threading operation. The following procedures have been used in the past:

(1) After threading a maximum of 6 pairs of sheets, the newly installed sheets can be hair-pinned (or vibrated partially) into the soil, enough to guarantee stability of the wall. In some cases, each pair of sheets is welded to the threading frame using angles. This procedure allows a larger number of sheets to be threaded before the sheets must be partially driven.

(2) A combination of welding and using come-a-longs to secure the sheets safely to the frame has also been used successfully.

(3) Another method is to use a vibratory hammer with a short sling, approximately 6-feet long, attached to the base of the hammer. This sling and shackle is used to hook and thread the sheets. After proper threading, the vibratory hammer is used to drive that pair of sheets down to a height of approximately three (3) feet above the threading frame.

(a) By using this procedure, the sheet-threading worker can always be positioned on the frame and can walk out of the way during the actual threading and driving after he/she has threaded the interlocks.

(b) If the threading frame is located 6 feet or more above the ground or water, a safe walkway with guardrails or a horizontal lifeline must be provided at the frame location to provide fall protection.

H. The "sheet threading worker" may not be positioned on top of the sheets.

An excellent form of fall prevention around a cofferdam is to leave the top of sheets elevated between 42" and 45" as, below. This avoids having to maintain a wood or cable guardrail system.

Cofferdam Sheet

11.0 WOOD FALSEWORK AND DRIVEN PILE

Planning for fall prevention and protection for driven pile falsework should include:

- Pile driving operations.
- Access to cut-off, setting caps and blocking.
- Setting stringers.
- Stripping falsework.

A. Pile Driving Operations

(1) A Ladder Climbing Safety Device (LCSD) or retractable lanyard is mandatory when climbing leads.

LCSD on Leads

(2) After climbing to the work area, a secondary anchorage is required in addition to the LCSD or retractable lanyard.

(3) If necessary to unhook from the LCSD or retractable lanyard to perform work, then a system of 100% connection procedures will be used.

(4) Do not jump off the leads or tracks of the crane.

B. Access to Cut-off, Set Caps, Blocking and Set Stringers

(1) Install scaffolding for access using a ladder or a manlift. If scaffolding is used, the top should be between 36 inches and 48 inches below the cut-off level.

(2) Install proper ladder access.

(3) Install a horizontal lifeline as described, the “Horizontal Applications” section.

(4) Perform remaining work while connected to the horizontal lifeline at all times.

C. Setting Stringers

It is often necessary to climb onto the pile cap to unhook rigging and when setting stringers. This may put the worker in a position of having to connect at his/her feet. Therefore, when setting stringers, employees shall use a full body harness and shock-absorbing lanyard or a retractable lanyard connected directly to the employees back. A Fall Protection Plan with written Job Sponsor or other manager as approved by the District Manager is required when the anchorage is less than 36".

D. Stripping Falsework

Prior to the start of stripping operations, previously installed scaffolds, ladders, and lifelines need to be inspected and repaired if necessary. Subsequent inspections must be completed at the start of each shift by a competent person.

(1) Perform work inside areas protected with a guardrail system; or

(2) Perform stripping work while connected to a horizontal lifeline; and

(3) Use only the personal fall protection equipment specified in the design of the Fall Arrest System.

12.0 SAFETY NETS

Safety nets should be a last resort in any of our operations. If nets are required for fall protection in any of our operations the District Safety Manager will be contacted to help plan the operation.

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October 3, 2005

Federal OSHA Fall Protection Construction Regulations Compared With California, Oregon and Washington State Standards

Executive Summary

Although the Federal Occupational Safety and Health Administration (OSHA) has primary jurisdiction over all States, the OSHA Act allows States to have their own equivalent OSHA safety regulations. Twenty-nine states currently have their own safety regulations with varying degrees of independence.

Because of variations between state and federal standards, and varying interpretations too, employers working throughout the United States and trying to follow Federal OSHA regulations can find themselves in violation of state standards and/or state case law. Example: In Ohio, West Virginia, Texas, New Mexico and Montana, the employer can be sued in state court by the employee for willful negligence.

Which regulation or standard should you follow and when?

This document compares Federal CFR 1926.500 Subpart M, Fall Protection for Construction (NOT including scaffolds and ladders) with the State Standards for California, Oregon and Washington. It is designed to assist in the decision matrix of when to apply what standard to a job being performed in these states. It can also be used to incorporate the more stringent aspects of each standard to create a localized Fall Protection program.

It is important to realize that the Federal OSHA General Duty Clause 5(a)(1) rules when there is no other applicable regulation and a recognized standard such as ANSI or NFPA can be cited in support. Above all, every employer has a duty to protect all employees from injury. The 5(b) section of the OSHA Act requires each employer to comply with federal safety standards where he has control without regard to their or any other employees; also known as the multi-employer worksite policy.

Primary differences between the California, Oregon, Washington and Federal Regulation exist in the following areas:

- Working height from the ground (trigger height)
- Guardrail specifications
- Written fall protection plans
- Identifying types of fall protection systems.

Working height from the Ground

Federal OSHA allowed for exemptions to 29CFR1926 for California, Oregon, and Washington, which change the height that an employee can work off the ground without needing to be tied off from 6 feet to 7 ½ feet and 10 feet. This only applies to general leading edge work unless the employee is working in an area that is called out by a specific standard. Example: Oregon States changed the minimum threshold from the 6' to a 10' for general leading edge work but kept the 6' threshold for work performed around holes and skylights.

Guardrail Specifications

California OSHA sets the minimum height for guardrails at 42 inches while Federal, Oregon, and Washington follow 42" ±3" or 39 inches as the minimum height criteria. Federal and Oregon OSHA calls for toe boards to be a minimum of 3 ½ inches high while California and Washington State call for toe board minimum height to be 4 inches.

Written Fall Protection Plan

Washington State has the most stringent requirement. They require that a Company identify all potential fall hazards for any job and write how the hazard is going to be controlled. This needs to be posted at the jobsite and communicated to all employees. Federal, California, and Oregon Standards require a written fall protection plan only if a Controlled Access Zone is going to be employed. The Washington State criteria is best because most companies have problems recognizing a fall hazard in the environment around the work being performed. Evaluating potential hazards before the work is performed and writing down how each hazard will be mitigated allows for best control of the jobsite.

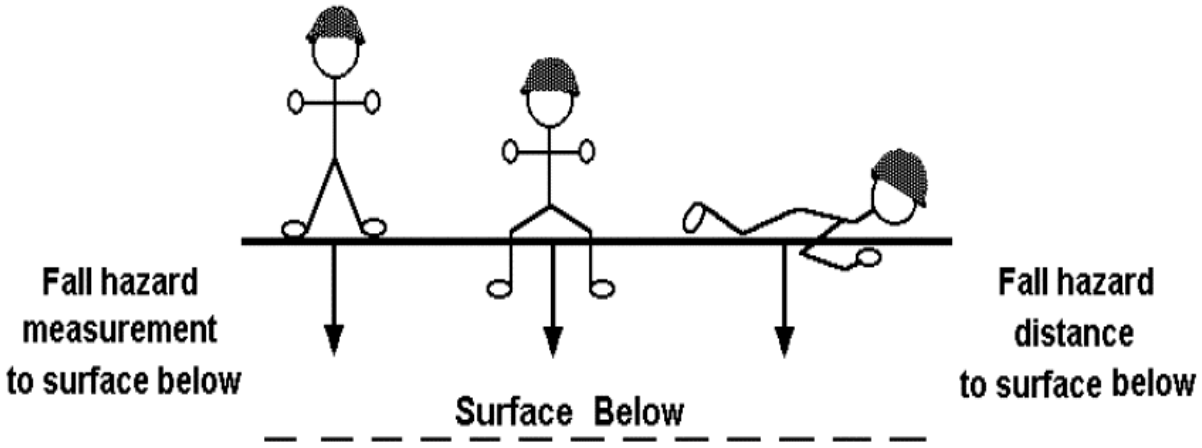
Identifying Types of Fall Protection Systems

Washington State Standard best define what needs to be done to protect employees working with different fall protection systems. (See Figure 1)

The Washington State Standard requires a company to look closely at the fall hazard and to identify it within the type of system that is going to be used. Once this is done the company gets specific information as to what qualifies for each type of system.

Roofing work is called out in Oregon and Washington State Standards with different criteria for protection.

Federal OSHA 1926.500 Subpart M Fall Protection Regulations Compared to CA, OR & WA State Standards



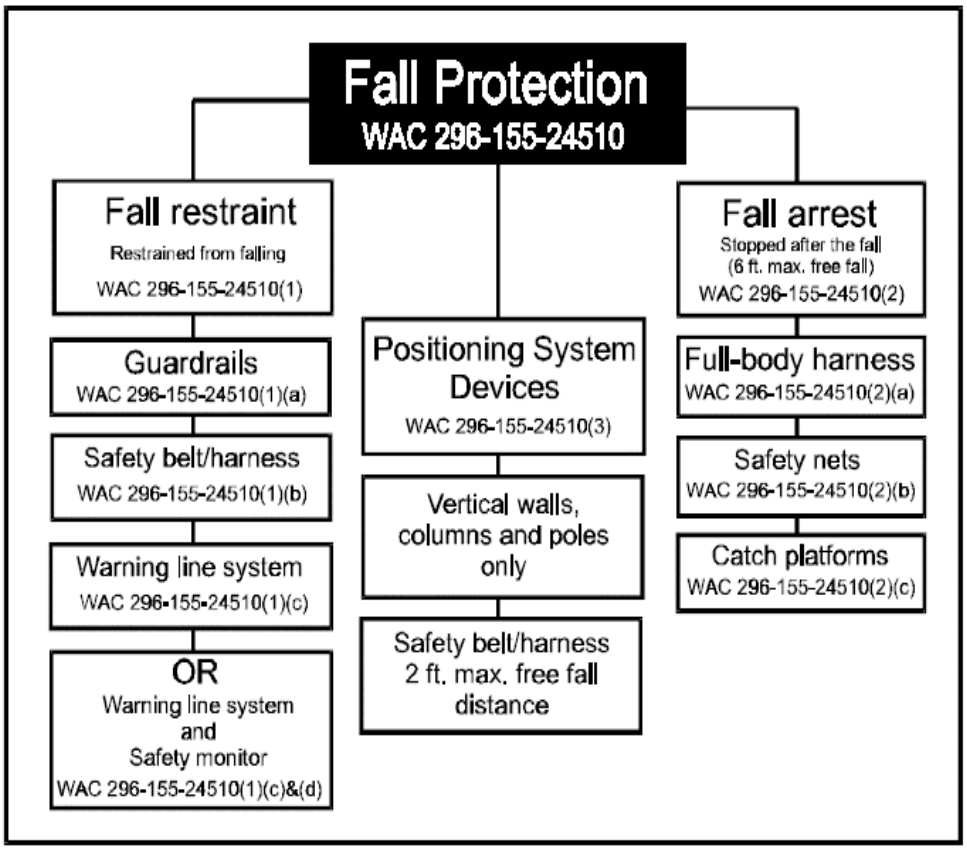


Figure 1: Washington State OSHA breaks the type of fall protection used out in an easy to read flow chart.

Additional Comments

California split the Federal Standard into smaller segments requiring a Company to find the specific Standard that applied to the specific work being performed.
Oregon State is the easiest to compare to Federal OSHA because they follow Fed OSHA to the letter except where they comment on specific differences.

We have tried to ensure that this comparison is as accurate as possible but holes do appear due to the fact that a State could have applied a work type under a separate guideline outside the scope of this comparison.

Additionally, it is important to note the recent changes to the American National Standards Institute (ANSI) Standards relevant to fall protection. Some Federal and State OSHA guidelines make performance references to ANSI A10.14-1991. This Standard was replaced with the new A10.32 Standard in 2004. A particular difference is the Maximum Arresting Force (MAF) applied with using a shock-absorbing lanyard 1,800 lbf v. 1,000 lbf respectively. This is one of several changes in the new ANSI A10 Standard. It could be important to incorporate this Standard within any fall protection program for construction work.

In conclusion, Oregon and California closely resemble the Federal OSHA Standard but Washington State requires a more through understanding of the application and job performed. The Washington State Standard does not easily match up to the Federal OSHA Standard and therefore requires you to have a through understanding of its Governance before performing work in the field in order to avoid a citation and/or monetary penalty for failing to comply with applicable OSHA regulations.

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Federal OSHA 29 CFR 1926 - Fall Protection for Construction	State OSHA Fall Protection Standards		
	California	Oregon	Washington
19 CFR 1026.500 - 503	Article 2 - Definitions (1504/1505) Article 24 - Fall Protection (1669/1672)	ORS 654 DIV 3 (Construction) Subdivision M (Fall Protection)	Chapter 296-155 WAC Part C-1 Construction Work Fall Restraint & Fall Arrest
Definitions.			
Anchorage means a secure point of attachment for lifelines, lanyards or deceleration devices.	✓	✓	**"Anchorage"** means a secure point of attachment for lifelines, lanyards, or deceleration devices which is capable of withstanding the forces specified in the
			"Approved" means, for the purpose of this section; tested and certified by the manufacturer, or any recognized national testing laboratory, to possess the strength requirements specified in this section.
Body belt (safety belt) means a strap with means both for securing it about the waist and for attaching it to a lanyard, lifeline, or deceleration device.	✓	✓	**"Body belt"** means a Type 1 safety belt used in conjunction with lanyard or lifeline for fall restraint only.
		(1) Body belt means a Type 1 safety belt used in conjunction with lanyard or lifeline for fall restraint only.	
Body harness means straps which may be secured about the employee 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.	✓	✓	**"Full body harness"** means a configuration of connected straps to distribute a fall arresting force over at least the thighs, shoulders and pelvis, with provisions for attaching a lanyard, lifeline, or deceleration devices.
			"Full body harness system" means a Class III full body harness and lanyard which is attached to an anchorage meeting the requirements of chapter 296-155 WAC, Part C-1; or attached to a horizontal or vertical lifeline which is properly secured to an anchorage(s) capable of withstanding the forces specified in the applicable sections of chapter 296-155 WAC.
Buckle means any device for holding the body belt or body harness closed around the employee's body.	✓	✓	
			"Catenary line" - see horizontal lifeline.
Competent person: see 1926.503(a)(2)		**Competent person** means one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them. NOTE: For the ease of the reader, this definition is reprinted here from 1926.32.	**"Competent person"** means an individual knowledgeable of fall protection equipment, including the manufacturers recommendations and instructions for the proper use, inspection, and maintenance; and who is capable of identifying existing and potential fall hazards; and who has the authority to take prompt corrective action to eliminate those hazards; and who is knowledgeable of the rules contained in this section regarding the erection, use, inspection, and maintenance of fall protection equipment and systems.
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	✓	✓	✓

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			"Continuous fall protection" means the design and use of a fall protection system such that no exposure to an elevated fall hazard occurs. This may require more than one fall protection system or a combination of prevention or protection measures.
			"Control zone" means the area between the warning line and the unprotected sides and edges of the walking/working surface.
Controlled access zone (CAZ) means an area in which certain work (e.g., overhand bricklaying) may take place without the use of guardrail systems, personal fall arrest systems, or safety net systems and access to the zone is controlled.	✓	✓	
Dangerous Equipment. Equipment (such as pickling or galvanizing tanks, degreasing units, machinery, electrical equipment, and other construction related equipment such as hoppers and conveyors) which, as a result of form or function, may be hazardous to employees who fall onto or into such equipment.	✓	✓	
Deceleration device means any mechanism, such as a rope grab, rip-stitch lanyard, specially-woven lanyard, tearing or deforming lanyards, automatic self-retracting lifelines/lanyards, etc., which serves to dissipate a substantial amount of energy during a fall arrest, or otherwise limit the energy imposed on an employee during fall arrest.	✓	✓	✓
Deceleration distance means the additional vertical distance a falling employee 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 an employee'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 employee comes to a full stop.	✓	✓	✓
	Drop Line (Safety Line). A vertical line from a fixed anchorage, independent of the work surface, to which the lanyard is affixed.		**"Drop line"** means a vertical lifeline secured to an upper anchorage for the purpose of attaching a lanyard or device.
Equivalent means alternative designs, materials, or methods to protect against a hazard which the employer can demonstrate will provide an equal or greater degree of safety for employees than the methods, materials or designs specified in the standard.	✓	✓	
Failure means load refusal, breakage, or separation of component parts. Load refusal is the point where the ultimate strength is exceeded.	✓	✓	✓

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		437-003-1500(2) Fall protection system means personal fall arrest system, fall restraint system, positioning device system, guardrail system, safety net system, warning line system, or slide guard system.	**"Fall arrest system"** means the use of multiple, approved safety equipment components such as; body harnesses, lanyards, deceleration devices, droplines, horizontal and/or vertical lifelines and anchorages, interconnected and rigged as to arrest a free fall. Compliance with anchorage strength requirements specified in the applicable sections of chapter 296-155 WAC, Part C-1 shall constitute approval of the anchorage.
			"Fall protection work plan" means a written planning document in which the employer identifies all areas on the job site where a fall hazard of 10 feet or greater exists. The plan describes the method or methods of fall protection to be utilized to protect employees, and includes the procedures governing the installation use, inspection, and removal of the fall protection method or methods which are selected by the employer. (See WAC 296-155-24505.)
			"Fall restraint system" means an approved device and any necessary components that function together to restrain an employee in such a manner as to prevent that employee from falling to a lower level. When standard guardrails are selected, compliance with applicable sections governing their construction and use shall constitute approval.
			"Fall distance" means the actual distance from the workers support to the level where a fall would stop.
Free fall means the act of falling before a personal fall arrest system begins to apply force to arrest the fall.	✓	✓	✓
Free fall distance means the vertical displacement of the fall arrest attachment point on the employee's body belt or body harness between onset of the fall and just before the system begins to apply force to arrest the fall. 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.	✓	✓	✓
Guardrail system means a barrier erected to prevent employees from falling to lower levels.	**Railing**. A barrier consisting of a top rail and a midrail secured to uprights and erected along the exposed sides and ends of platforms.	✓	
			"Handrail" means a rail used to provide employees with a handhold for support.
			"Hardware" means snap hooks, D rings, bucklers, carabiners, adjusters, O rings, that are used to attach the components of a fall protection system together.

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			"Horizontal lifeline" means a rail, rope, wire, or synthetic cable that is installed in a horizontal plane between two anchorages and used for attachment of a workers lanyard or lifeline device while moving horizontally; used to control dangerous pendulum like swing falls.
	Handrail. A rail used to provide employees with a handhold for support.		
Hole means a gap or void 2 inches (5.1 cm) or more in its least dimension, in a floor, roof, or other walking/working surface.	✓	✓	"Floor hole" means an opening measuring less than 12 inches but more than 1 inch in its least dimension in any floor, roof, or platform through which materials but not persons may fall, such as a belt hole, pipe opening, or slot opening.
			"Floor opening" means an opening measuring 12 inches or more in its least dimension in any floor, roof, or platform, through which persons may fall.
Infeasible means that it is impossible to perform the construction work using a conventional fall protection system (i.e., guardrail system, safety net system, or personal fall arrest system) or that it is technologically impossible to use any one of these systems to provide fall protection.		✓	
Lanyard means 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.	**Lanyard.** A flexible line to secure a wearer of a safety belt or harness to a drop line, lifeline, or fixed anchorage.	✓	**"Lanyard"** means a flexible line of webbing, rope, or cable used to secure a body belt or harness to a lifeline or an anchorage point usually 2, 4, or 6 feet long.
Leading edge means the edge of a floor, roof, or formwork for a floor or other walking/working surface (such as the deck) which changes location as additional floor, roof, decking, or formwork sections are placed, formed, or constructed. A leading edge is considered to be an "unprotected side and edge" during periods when it is not actively and continuously under construction.	✓	✓	**"Leading edge"** means the advancing edge of a floor, roof, or formwork which changes location as additional floor, roof, or formwork sections are placed, formed, or constructed. Leading edges not actively under construction are considered to be "unprotected sides and edges, and positive methods of fall arrest or fall restraint shall be required to protect exposed workers.
Lifeline means a component consisting of a flexible line for connection to an anchorage at one end to hang vertically (vertical lifeline), or for connection to anchorages at both ends to stretch horizontally (horizontal lifeline), and which serves as a means for connecting other components of a personal fall arrest system to the anchorage.	**Lifeline**. A horizontal line (i.e. catenary line) between two fixed anchorages, independent of the work surface, to which the lanyard is secured either by tying off or by means of a suitable sliding connection. For the purposes of these orders, lifelines may be vertical as well as horizontal (i.e. when used with a body harness).	✓	**"Lifeline"** means a vertical line from a fixed anchorage or between two horizontal anchorages, independent of walking or working surfaces, to which a lanyard or device is secured. Lifeline as referred to in this text is one which is part of a fall protection system used as back-up safety for an elevated worker.
			"Locking snap hook" means a connecting snap hook that requires two separate forces to open the gate; one to deactivate the gatekeeper and a second to depress and open the gate which automatically closes when released; used to minimize roll out or accidental disengagement.

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Low-slope roof means a roof having a slope less than or equal to 4 in 12 (vertical to horizontal).			✓
Lower levels means those areas or surfaces to which an employee can fall. Such areas or surfaces include, but are not limited to, ground levels, floors, platforms, ramps, runways, excavations, pits, tanks, material, water, equipment, structures, or portions thereof.	✓	✓	
Mechanical equipment means all motor or human propelled wheeled equipment used for roofing work, except wheelbarrows and mopcarts.	✓	✓	✓
	Midrail. A rail approximately midway between the top rail and platform, that is secured to the uprights erected along the exposed sides and ends of platforms.		"Nose, nosing" means that portion of a tread projecting beyond the face of the riser immediately below.
Opening means a gap or void 30 inches (76 cm) or more high and 18 inches (48 cm) or more wide, in a wall or partition, through which employees can fall to a lower level.	**Opening.** An opening in any floor or platform, 12 inches or more in the least horizontal dimension. It includes: stairway floor openings, ladderway floor openings, hatchways and chute floor openings.	✓	
Overhand bricklaying and related work means the process of laying bricks and masonry units such that the surface of the wall to be jointed is on the opposite side of the wall from the mason, requiring the mason to lean over the wall to complete the work. Related work includes mason tending and electrical installation incorporated into the brick wall during the overhand bricklaying process.		NOTE: Overhand bricklaying from scaffolds is addressed in Subdivision L.	
			"Platform" means a walking/working surface for persons, elevated above the surrounding floor or ground, such as a balcony or platform for the operation of machinery and equipment.
			"Positioning belt" means a single or multiple strap that can be secured around the workers body to hold the user in a work position; for example, a linemans belt, a rebar belt, or saddle belt.
	Personal Fall Protection System. A personal fall protection system includes personal fall arrest systems, positioning device systems, fall restraint systems, safety nets and guardrails.		
Personal fall arrest system means a system used to arrest an employee in a fall from a working level. It consists of an anchorage, connectors, a body belt or 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.	✓	✓	
		437-003-1500(3) Personal fall restraint system means a fall protection system that prevents the user from falling any distance. The system is comprised of either a body belt or 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.	

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Positioning device system means a body belt or body harness system rigged to allow an employee to be supported on an elevated vertical surface, such as a wall, and work with both hands free while leaning.	✓	✓	✓
	Personal Fall Restraint System. A system used to prevent an employee from falling. It consists of anchorages, connectors, body belt/harness. It may include, lanyards, lifelines, and rope grabs designed for that purpose.		
Qualified Person: One who, by possession of a recognized degree, certificate or professional standing or who by extensive knowledge, training and experience has demonstrated ability to solve/resolve problems relating to the work or project. (EFSS Note: A Qualified Person must first be a Competent Person)	**Qualified Person, Attendant or Operator.** A person designated by the employer who by reason of training, experience or instruction has demonstrated the ability to safely perform all assigned duties and, when required, is properly licensed in accordance with federal, state, or local laws and regulations.	**Qualified person** means one who, by possession of a recognized degree, certificate or professional standing, or who by extensive knowledge, training and experience, has successfully demonstrated his/her ability to solve or resolve problems relating to the subject matter, the work or the project. NOTE: For the ease of the reader, this definition is reprinted here from §1926.32.	
		437-003-1500(4) Rake edge means the inclined roof edges, such as those on the gable end of a building.	
			"Restraint line" means a line from a fixed anchorage or between two anchorages to which an employee is secured in such a way as to prevent the worker from falling to a lower level.
			"Riser height" means the vertical distance from the top of a tread to the top of the next higher tread or platform/landing or the distance from the top of a platform/landing to the top of the next higher tread or platform/landing.
			"Roll out" means unintentional disengagement of a snap hook caused by the gate being depressed under torque or contact while twisting or turning; a particular concern with single action snap hooks that do not have a locking gatekeeper.
Rope grab means a deceleration device which travels on a lifeline and automatically, by friction, engages the lifeline and locks so as to arrest the fall of an employee. A rope grab usually employs the principle of inertial locking, cam/lever locking, or both.	✓	✓	**"Rope grab"** means a fall arrester that is designed to move up or down a lifeline suspended from a fixed overhead or horizontal anchorage point, or lifeline, to which the belt or harness is attached. In the event of a fall, the rope grab locks onto the lifeline rope through compression to arrest the fall. The use of a rope grab device is restricted for all restraint applications. (Refer to WAC 296-155-24510(1)(b)(iii)).
Roof means the exterior surface on the top of a building. This does not include floors or formwork which, because a building has not been completed, temporarily become the top surface of a building.		✓	✓
Roofing work means the hoisting, storage, application, and removal of roofing materials and equipment, including related insulation, sheet metal, and vapor barrier work, but not including the construction of the roof deck.		**437-003-1500(5) Roofing work** means the hoisting, storage, application, and removal of roofing materials and equipment, including related insulation, sheet metal, and vapor barrier work, but not including the construction of the roof deck and leading edge work.	✓

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			"Runway" means a passageway for persons, elevated above the surrounding floor or ground level, such as a footwalk along shafting or a walkway between buildings.
	Safety Line. One that is provided to protect a worker from falls caused by failure of scaffolds, working platforms, or loss of balance, and shall extend to within 4 feet of ground or other stable surface.		**"Safety line" - see lifeline.**
Safety-monitoring system means a safety system in which a competent person is responsible for recognizing and warning employees of fall hazards.	✓	✓	**"Safety monitor system"** means a system of fall restraint used in conjunction with a warning line system only, where a competent person as defined by this part, having no additional duties, monitors the proximity of workers to the fall hazard when working between the warning line and the unprotected sides and edges including, the leading edge of a low pitched roof or walking/working surface. WAC 296-155 WAC Part K "Safety monitoring system" means a safety system in which a competent person monitors the safety of all employees in a roofing crew, and warns them when it appears to the monitor that they are unaware of the hazard or are acting in an unsafe manner. The competent person must be on the same roof and within visual
Self-retracting lifeline/lanyard means a deceleration device containing a drum-wound line which can be slowly extracted from, or retracted onto, the drum under slight tension during normal employee movement, and which, after onset of a fall, automatically locks the drum and arrests the fall.	✓	✓	✓
			"Shock absorbing lanyard" means a flexible line of webbing, cable, or rope used to secure a body belt or harness to a lifeline or anchorage point that has an integral shock absorber.
			"Single action snap hook" means a connecting snap hook that requires a single force to open the gate which automatically closes when released.
		437-003-1500(6) Slide guard system means a fall protection system designed to prevent employees from sliding off a sloped roof to a lower level. The system consists of manufactured brackets (roof brackets) used in conjunction with dimensional lumber, or a site built system of similar design and dimension.	
Snaphook means a connector comprised of a hook-shaped member with a normally closed keeper, or similar arrangement, which may be opened to permit the hook to receive an object and, when released, automatically closes to retain the object. Snaphooks are generally one of two types:	**Snaphook.** A connector comprised of a hook-shaped member with a normally closed keeper, or similar arrangement, which may be opened to permit the hook to receive an object and, when released, automatically closes to retain the object.	✓	**"Snap hook"** means a self-closing connecting device with a gatekeeper latch or similar arrangement that will remain closed until manually opened. This includes single action snap hooks that open when the gatekeeper is depressed and double action snap hooks that require a second action on a gatekeeper before the gate can be opened.
The locking type with a self-closing, self-locking keeper which remains closed and locked until unlocked and pressed open for connection or disconnection; or		✓	✓

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The non-locking type with a self-closing keeper which remains closed until pressed open for connection or disconnection. As of January 1, 1998, the use of a non-locking snaphook as part of personal fall arrest systems and positioning device systems is prohibited.		✓	✓
			"Stair platform" means an extended step or landing breaking a continuous run of stairs.
See 1926.1050 and 1926.1051 Subpart X Ladders for regulations on Stairs and Stairways			"Stairrail system" means a vertical barrier erected along the unprotected sides and edges of a stairway to prevent employees from falling to lower levels. The top surface of a stairrail system may also be a "handrail."
			"Stairs, stairways" means a series of steps leading from one level or floor to another, or leading to platforms, pits, boiler rooms, crossovers, or around machinery, tanks, and other equipment that are used more or less continuously or routinely by employees or only occasionally by specific individuals. For the purpose of this part, a series of steps and landings having three or more rises constitutes stairs or stairway.
			"Standard railing" means a vertical barrier erected along exposed edges of a floor opening, wall opening, ramp, platform, or runway to prevent falls of persons.
			"Standard strength and construction" means any construction of railings, covers, or other guards that meets the requirements of this part.
			"Static line" - see horizontal lifeline.
Steep roof means a roof having a slope greater than 4 in 12 (vertical to horizontal).		✓	✓
			"Strength member" means any component of a fall protection system that could be subject to loading in the event of a fall.

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Toeboard means a low protective barrier that will prevent the fall of materials and equipment to lower levels and provide protection from falls for personnel.	**Toeboard.** A barrier secured along the sides and ends of a platform at the platform level used to guard against the falling of material.	✓	"Toeboard" means a vertical barrier at floor level erected along exposed edges of a floor opening, wall opening, platform, runway, or ramp to prevent falls of materials.
			"Tread depth" means the horizontal distance from front to back of tread (excluding nosing, if any).
Unprotected sides and edges means any side or edge (except at entrances to points of access) of a walking/working surface, e.g., floor, roof, ramp, or runway where there is no wall or guardrail system at least 39 inches (1.0 m) high.	✓	✓	**"Unprotected sides and edges"** means any side or edge (except at entrances to points of access) of a floor, roof, ramp or runway where there is no wall or guardrail system as defined in WAC 296-155-505(7).
			"Unprotected side or edge" means any side or edge of a roof perimeter where there is no wall three feet (.9 meters) or more in height.
	Wall opening. A gap or void 30 inches or more high and 18 inches or more wide, in a wall or partition, through which employees can fall to a lower level.		"Wall opening" means an opening at least 30 inches high and 18 inches wide, in any wall or partition, through which persons may fall, such as an opening for a window, a yard arm doorway or chute opening.
Walking/working surface means any surface, whether horizontal or vertical on which an employee walks or works, including, but not limited to, floors, roofs, ramps, bridges, runways, formwork and concrete reinforcing steel but not including ladders, vehicles, or trailers, on which employees must be located in order to perform their job duties.		**437-003-1500(7) Walking/working surface** means any surface, whether horizontal or vertical on which an employee walks or works, including, but not limited to, floors, roofs, ramps, bridges, runways, formwork, beams, columns, trusses and concrete reinforcing steel but not ladders, vehicles, or trailers, on which employees must be located in order to perform their job duties.	**"Walking/working surface"** means for the purpose of this section, any area whose dimensions are 45 inches or greater in all directions, through which workers pass or conduct work.
Warning line system means a barrier erected on a roof to warn employees that they are approaching an unprotected roof side or edge, and which designates an area in which roofing work may take place without the use of guardrail, body belt, or safety net systems to protect employees in the area.		✓	**"Warning line system"** means a barrier erected on a walking and working surface or a low pitch roof (4 in 12 or less), to warn employees that they are approaching an unprotected fall hazard(s).
Work area means that portion of a walking/working surface where job duties are being performed.		✓	✓
			This section sets forth requirements for employers to provide and enforce the use of fall protection for employees in construction, alteration, repair, maintenance (including painting and decorating), demolition workplaces, and material handling covered under chapter 296-155 WAC.
1926.501(a)(2)			WAC 296-155-24510 Fall restraint, fall arrest systems.
The employer shall determine if the walking/working surfaces on which its employees are to work have the strength and structural integrity to support employees safely. Employees shall be allowed to work on those surfaces only when the surfaces have the requisite strength and structural integrity.	✓	✓	✓

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1926.501(b)(1)		NOTE: All of 1926.501(b) was repealed. In Oregon, 437-003-1501 applies.	
"Unprotected sides and edges." Each employee on a walking/working surface (horizontal and vertical surface) with an unprotected side or edge which is 6 feet (1.8 m) or more above a lower level shall be protected from falling by the use of guardrail systems, safety net systems, or personal fall arrest systems.	a) Approved personal fall arrest, personal fall restraint or positioning systems shall be worn by those employees whose work exposes them to falling in excess of 7 1/2 feet from the perimeter of a structure, unprotected sides and edges, leading edges, through shaftways and openings, sloped roof surfaces steeper than 7:12, or other sloped surfaces steeper than 40 degrees not otherwise adequately protected under the provisions of these Orders	437-003-1501 General Fall Protection. Except as otherwise provided in paragraphs (1) through (4) of this section, when employees are exposed to a hazard of falling 10 feet or more to a lower level, the employer shall ensure that fall protection systems are provided, installed, and implemented according to the criteria in 1926.502.	When employees are exposed to a hazard of falling from a location 10 feet or more in height, the employer shall ensure that fall restraint, fall arrest systems or positioning device systems are provided, installed, and implemented according to the following requirements.
"Leading edges."		NOTE: All of 1926.501(b) was repealed. In Oregon, 437-003-1501 applies.	
1926.501(b)(2)(i)			
Each employee who is constructing a leading edge 6 feet (1.8 m) or more above lower levels shall be protected from falling by guardrail systems, safety net systems, or personal fall arrest systems. Exception: When the employer can demonstrate that it is infeasible or creates a greater hazard to use these systems, the employer shall develop and implement a fall protection plan which meets the requirements of paragraph (k) of 1926.502.	a) Approved personal fall arrest, personal fall restraint or positioning systems shall be worn by those employees whose work exposes them to falling in excess of 7 1/2 feet from the perimeter of a structure, unprotected sides and edges, leading edges, through shaftways and openings, sloped roof surfaces steeper than 7:12, or other sloped surfaces steeper than 40 degrees not otherwise adequately protected under the provisions of these Orders	NOTE: All of 1926.501(b) was repealed. In Oregon, 437-003-1501 applies. 437-003-1501 applies: "...exposed to a hazard of falling 10 feet or more to a lower level…"	When employees are exposed to a hazard of falling from a location 10 feet or more in height, the employer shall ensure that fall restraint, fall arrest systems or positioning device systems are provided, installed, and implemented according to the following requirements.
Note: There is a presumption that it is feasible and will not create a greater hazard to implement at least one of the above-listed fall protection systems. Accordingly, the employer has the burden of establishing that it is appropriate to implement a fall protection plan which complies with 1926.502(k) for a particular workplace situation, in lieu of implementing any of those systems.		NOTE: All of 1926.501(b) was repealed. In Oregon, 437-003-1501 applies.	
1926.501(b)(2)(ii)			
Each employee on a walking/working surface 6 feet (1.8 m) or more above a lower level where leading edges are under construction, but who is not engaged in the leading edge work, shall be protected from falling by a guardrail system, safety net system, or personal fall arrest system. If a guardrail system is chosen to provide the fall protection, and a controlled access zone has already been established for leading edge work, the control line may be used in lieu of a guardrail along the edge that parallels the leading edge.	a) Approved personal fall arrest, personal fall restraint or positioning systems shall be worn by those employees whose work exposes them to falling in excess of 7 1/2 feet from the perimeter of a structure, unprotected sides and edges, leading edges, through shaftways and openings, sloped roof surfaces steeper than 7:12, or other sloped surfaces steeper than 40 degrees not otherwise adequately protected under the provisions of these Orders	NOTE: All of 1926.501(b) was repealed. In Oregon, 437-003-1501 applies. 437-003-1501 applies: "...exposed to a hazard of falling 10 feet or more to a lower level…"	When employees are exposed to a hazard of falling from a location 10 feet or more in height, the employer shall ensure that fall restraint, fall arrest systems or positioning device systems are provided, installed, and implemented according to the following requirements.

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1926.501(b)(3)			
"Hoist areas." Each employee in a hoist area shall be protected from falling 6 feet (1.8 m) or more to lower levels by guardrail systems or personal fall arrest systems. If guardrail systems, [or chain, gate, or guardrail] or portions thereof, are removed to facilitate the hoisting operation (e.g., during landing of materials), and an employee must lean through the access opening or out over the edge of the access opening (to receive or guide equipment and materials, for example), that employee shall be protected from fall hazards by a personal fall arrest system.A13	a) Approved personal fall arrest, personal fall restraint or positioning systems shall be worn by those employees whose work exposes them to falling in excess of 7 1/2 feet from the perimeter of a structure, unprotected sides and edges, leading edges, through shaftways and openings, sloped roof surfaces steeper than 7:12, or other sloped surfaces steeper than 40 degrees not otherwise adequately protected under the provisions of these Orders	NOTE: All of 1926.501(b) was repealed. In Oregon, 437-003-1501 applies. 437-003-1501 applies: "...exposed to a hazard of falling 10 feet or more to a lower level…"	When employees are exposed to a hazard of falling from a location 10 feet or more in height, the employer shall ensure that fall restraint, fall arrest systems or positioning device systems are provided, installed, and implemented according to the following requirements.
..1926.501(b)(4)		NOTE: All of 1926.501(b) was repealed. In Oregon, 437-003-1501 applies.	
1926.501(b)(4)			
"Holes."		✓ 437-003-1501	
1926.501(b)(4)(i)			
Each employee on walking/working surfaces shall be protected from falling through holes (including skylights) more than 6 feet (1.8 m) above lower levels, by personal fall arrest systems, covers, or guardrail systems erected around such holes.	a) Approved personal fall arrest, personal fall restraint or positioning systems shall be worn by those employees whose work exposes them to falling in excess of 7 1/2 feet from the perimeter of a structure, unprotected sides and edges, leading edges, through shaftways and openings, sloped roof surfaces steeper than 7:12, or other sloped surfaces steeper than 40 degrees not otherwise adequately protected under the provisions of these Orders	✓ 437-003-1501 (1)(a)	
1926.501(b)(4)(ii)			
Each employee on a walking/working surface shall be protected from tripping in or stepping into or through holes (including skylights) by covers.		✓ 437-003-1501 (1)(b)	
1926.501(b)(4)(iii)			
Each employee on a walking/working surface shall be protected from objects falling through holes (including skylights) by covers.		✓ 437-003-1501 (1)(c)	
		(d) Smoke domes or skylight fixtures are not considered covers for the purpose of this section unless they meet the strength requirements of 29 CFR 1926.502(i).	
		(2) Wall openings. Each employee working on, at, above, or near wall openings (including those with chutes attached) where the outside bottom edge of the wall opening is 6 feet (1.8 m) or more above lower levels and the inside bottom edge of the wall opening is less than 39 inches (1.0 m) above the walking/working surface, shall be protected from falling by the use of personal fall arrest systems, personal fall restraint systems, safety net systems, or guardrail systems.	
		(3) Established floors, mezzanines, balconies and walkways. Each employee on established floors, mezzanines, balconies and walkways, with an unprotected side or edge 6 feet (1.8 m) or more above a lower level, shall be protected from falling by the use of personal fall arrest systems, personal fall restraint systems, safety net systems, or guardrail systems.	

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1926.501(b)(5)			
"Formwork and reinforcing steel." Each employee on the face of formwork or reinforcing steel shall be protected from falling 6 feet (1.8 m) or more to lower levels by personal fall arrest systems, safety net systems, or positioning device systems.		NOTE: All of 1926.501(b) was repealed. In Oregon, 437-003-1501 applies. 437-003-1501 applies: "...exposed to a hazard of falling 10 feet or more to a lower level…"	
1926.501(b)(6)		NOTE: All of 1926.501(b) was repealed. In Oregon, 437-003-1501 applies.	
"Ramps, runways, and other walkways." Each employee on ramps, runways, and other walkways shall be protected from falling 6 feet (1.8 m) or more to lower levels by guardrail systems.		NOTE: All of 1926.501(b) was repealed. In Oregon, 437-003-1501 applies. 437-003-1501 applies: "...exposed to a hazard of falling 10 feet or more to a lower level…"	WAC 296-155-515 Ramps Standard railings. Ramps, runways and inclined walkways shall be provided with standard railings when located four feet or more above ground or floor level.
1926.501(b)(7)			
"Excavations."		(4) Excavations.	
1926.501(b)(7)(i)			
Each employee at the edge of an excavation 6 feet (1.8 m) or more in depth shall be protected from falling by guardrail systems, fences, or barricades when the excavations are not readily seen because of plant growth or other visual barrier;		✓ 437-003-1501 (4)(a)	
..1926.501(b)(7)(ii)			
1926.501(b)(7)(ii)			
Each employee at the edge of a well, pit, shaft, and similar excavation 6 feet (1.8 m) or more in depth shall be protected from falling by guardrail systems, fences, barricades, or covers.		✓ 437-003-1501 (4)(b)	
1926.501(b)(8)			
"Dangerous equipment."			
1926.501(b)(8)(i)			
Each employee less than 6 feet (1.8 m) above dangerous equipment shall be protected from falling into or onto the dangerous equipment by guardrail systems or by equipment guards.		437-003-1501 (5) Dangerous Equipment. Each employee shall be protected from falls into or onto dangerous equipment by personal fall arrest systems, personal fall restraint systems, safety net systems, guardrail systems or equipment guards.	
1926.501(b)(8)(ii)			
Each employee 6 feet (1.8 m) or more above dangerous equipment shall be protected from fall hazards by guardrail systems, personal fall arrest systems, or safety net systems.		NOTE: All of 1926.501(b) was repealed. In Oregon, 437-003-1501 applies. 437-003-1501 applies: "...exposed to a hazard of falling 10 feet or more to a lower level…"	
1926.501(b)(9)			
"Overhand bricklaying and related work."		NOTE: All of 1926.501(b) was repealed. In Oregon, 437-003-1501 applies.	

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1926.501(b)(9)(i)			
Except as otherwise provided in paragraph (b) of this section, each employee performing overhand bricklaying and related work 6 feet (1.8 m) or more above lower levels, shall be protected from falling by guardrail systems, safety net systems, personal fall arrest systems, or shall work in a controlled access zone.		NOTE: All of 1926.501(b) was repealed. In Oregon, 437-003-1501 applies.	
1926.501(b)(9)(ii)			
Each employee reaching more than 10 inches (25 cm) below the level of the walking/working surface on which they are working, shall be protected from falling by a guardrail system, safety net system, or personal fall arrest system.		NOTE: All of 1926.501(b) was repealed. In Oregon, 437-003-1501 applies.	
Note: Bricklaying operations performed on scaffolds are regulated by subpart L - Scaffolds of this part.		NOTE: All of 1926.501(b) was repealed. In Oregon, 437-003-1501 applies.	
		NOTE: All of 1926.501(b) was repealed. In Oregon, 437-003-1501 applies.	
..1926.501(b)(10)			
1926.501(b)(10)			
"Roofing work on Low-slope roofs." Except as otherwise provided in paragraph (b) of this section, each employee engaged in roofing activities on low-slope roofs, with unprotected sides and edges 6 feet (1.8 m) or more above lower levels shall be protected from falling by guardrail systems, safety net systems, personal fall arrest systems, or a combination of warning line system and guardrail system, warning line system and safety net system, or warning line system and personal fall arrest system, or warning line system and safety monitoring system. Or, on roofs 50-feet (15.25 m) or less in width (see Appendix A to subpart M of this part), the use of a safety monitoring system alone [i.e. without the warning line system] is permitted.		NOTE: All of 1926.501(b) was repealed. In Oregon, 437-003-1501 applies.	
1926.501(b)(11)			
"Steep roofs." Each employee on a steep roof with unprotected sides and edges 6 feet (1.8 m) or more above lower levels shall be protected from falling by guardrail systems with toeboards, safety net systems, or personal fall arrest systems.		NOTE: All of 1926.501(b) was repealed. In Oregon, 437-003-1501 applies.	

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1926.501(b)(12)			
"Precast concrete erection." Each employee engaged in the erection of precast concrete members (including, but not limited to the erection of wall panels, columns, beams, and floor and roof "tees") and related operations such as grouting of precast concrete members, who is 6 feet (1.8 m) or more above lower levels shall be protected from falling by guardrail systems, safety net systems, or personal fall arrest systems, unless another provision in paragraph (b) of this section provides for an alternative fall protection measure. Exception: When the employer can demonstrate that it is infeasible or creates a greater hazard to use these systems, the employer shall develop and implement a fall protection plan which meets the requirements of paragraph (k) of 1926.502.		NOTE: All of 1926.501(b) was repealed. In Oregon, 437-003-1501 applies.	
Note: There is a presumption that it is feasible and will not create a greater hazard to implement at least one of the above-listed fall protection systems. Accordingly, the employer has the burden of establishing that it is appropriate to implement a fall protection plan which complies with 1926.502(k) for a particular workplace situation, in lieu of implementing any of those systems.		NOTE: All of 1926.501(b) was repealed. In Oregon, 437-003-1501 applies.	
..1926.501(b)(13)			
1926.501(b)(13)			
"Residential construction." Each employee engaged in residential construction activities 6 feet (1.8 m) or more above lower levels shall be protected by guardrail systems, safety net system, or personal fall arrest system unless another provision in paragraph (b) of this section provides for an alternative fall protection measure. Exception: When the employer can demonstrate that it is infeasible or creates a greater hazard to use these systems, the employer shall develop and implement a fall protection plan which meets the requirements of paragraph (k) of 1926.502.		NOTE: All of 1926.501(b) was repealed. In Oregon, 437-003-1501 applies.	
Note: There is a presumption that it is feasible and will not create a greater hazard to implement at least one of the above-listed fall protection systems. Accordingly, the employer has the burden of establishing that it is appropriate to implement a fall protection plan which complies with 1926.502(k) for a particular workplace situation, in lieu of implementing any of those systems.		NOTE: All of 1926.501(b) was repealed. In Oregon, 437-003-1501 applies.	
1926.501(b)(14)			
"Wall openings." Each employee working on, at, above, or near wall openings (including those with chutes attached) where the outside bottom edge of the wall opening is 6 feet (1.8 m) or more above lower levels and the inside bottom edge of the wall opening is less than 39 inches (1.0 m) above the walking/working surface, shall be protected from falling by the use of a guardrail system, a safety net system, or a personal fall arrest system.		✓ 437-003-1501 (2)	

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1926.501(b)(15)			
"Walking/working surfaces not otherwise addressed." Except as provided in 1926.500(a)(2) or in 1926.501 (b)(1) through (b)(14), each employee on a walking/working surface 6 feet (1.8 m) or more above lower levels shall be protected from falling by a guardrail system, safety net system, or personal fall arrest system.		NOTE: All of 1926.501(b) was repealed. In Oregon, 437-003-1501 applies.	
1926.501(c)			
"Protection from falling objects." When an employee is exposed to falling objects, the employer shall have each employee wear a hard hat and shall implement one of the following measures:		✓	
1926.501(c)(1)			
Erect toeboards, screens, or guardrail systems to prevent objects from falling from higher levels; or,	✓	✓	✓
..1926.501(c)(2)			
1926.501(c)(2)			
Erect a canopy structure and keep potential fall objects far enough from the edge of the higher level so that those objects would not go over the edge if they were accidentally displaced; or,		✓	✓
1926.501(c)(3)			
Barricade the area to which objects could fall, prohibit employees from entering the barricaded area, and keep objects that may fall far enough away from the edge of a higher level so that those objects would not go over the edge if they were accidentally displaced.		✓	✓
1926.502(a)			
"General."			
1926.502(a)(1)			
Fall protection systems required by this part shall comply with the applicable provisions of this section.			
1926.502(a)(2)			
Employers shall provide and install all fall protection systems required by this subpart for an employee, and shall comply with all other pertinent requirements of this subpart before that employee begins the work that necessitates the fall protection.		✓	
1926.502(b)			Chapter 296-155 WAC Park K
"Guardrail systems." Guardrail systems and their use shall comply with the following provisions:		✓	Standard guardrails as described in chapter 296-155 WAC, Part K (7) Standard specifications.
			✓

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1926.502(b)(1)			
Top edge height of top rails, or equivalent guardrail system members, shall be 42 inches (1.1 m) plus or minus 3 inches (8 cm) above the walking/working level. When conditions warrant, the height of the top edge may exceed the 45-inch height, provided the guardrail system meets all other criteria of this paragraph.	(a) Railings shall be constructed of wood, as follows, or in an equally substantial manner from other materials, and shall consist of a top rail not less than 42 inches or more than 45 inches in height measured from the upper surface of the top rail to the floor, platform, runway or ramp level and a midrail. The midrail shall be halfway between the top rail and the floor, platform, runway or ramp. "Selected lumber" (see definitions), free from damage that affects its strength, shall be used for railings constructed of wood.	✓	(a) A standard railing shall consist of top rail, intermediate rail, toe board, and posts, and shall have a vertical height of 42 inches (1.1m) plus or minus 3 inches (8cm)(39-45) inches from upper surface of top rail to floor, platform, runway, or ramp level. When conditions warrant, the height of the top edge may exceed the 45-inch height, provided the guardrail system meets all other criteria of this subsection. The intermediate rail shall be halfway between the top rail and the floor, platform, runway, or ramp. The ends of the rails shall not overhang the terminal posts except where such overhang does not constitute a projection hazard.
Note: When employees are using stilts, the top edge height of the top rail, or equivalent member, shall be increased an amount equal to the height of the stilts.		✓	✓
..1926.502(b)(2)			
1926.502(b)(2)			
Midrails, screens, mesh, intermediate vertical members, or equivalent intermediate structural members shall be installed between the top edge of the guardrail system and the walking/working surface when there is no wall or parapet wall at least 21 inches (53 cm) high.		✓	
1926.502(b)(2)(i)			
Midrails, when used, shall be installed at a height midway between the top edge of the guardrail system and the walking/working level.	The midrail shall be halfway between the top rail and the floor, platform, runway or ramp. "Selected lumber" (see definitions), free from damage that affects its strength, shall be used for railings constructed of wood.	✓	✓
1926.502(b)(2)(ii)			
Screens and mesh, when used, shall extend from the top rail to the walking/working level and along the entire opening between top rail supports.		✓	
1926.502(b)(2)(iii)			
Intermediate members (such as balusters), when used between posts, shall be not more than 19 inches (48 cm) apart.		✓	
1926.502(b)(2)(iv)			
Other structural members (such as additional midrails and architectural panels) shall be installed such that there are no openings in the guardrail system that are more than 19 inches (.5 m) wide.		✓	

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1926.502(b)(3)			
Guardrail systems shall be capable of withstanding, without failure, a force of at least 200 pounds (890 N) applied within 2 inches (5.1 cm) of the top edge, in any outward or downward direction, at any point along the top edge.	(f) All guardrails, including their connections and anchorage, shall be capable of withstanding a load of 13 pounds per linear foot applied either horizontally or vertically downward at the top rail.	✓	(v) The anchoring of posts and framing of members for railings of all types shall be of such construction that the completed structure shall be capable of withstanding a load of at least 200 pounds applied in any direction at any point on the top rail, with a minimum of deflection.
..1926.502(b)(4)			
1926.502(b)(4)			
When the 200 pound (890 N) test load specified in paragraph (b)(3) of this section is applied in a downward direction, the top edge of the guardrail shall not deflect to a height less than 39 inches (1.0 m) above the walking/working level. Guardrail system components selected and constructed in accordance with the Appendix B to subpart M of this part will be deemed to meet this requirement.		✓	✓
1926.502(b)(5)			
Midrails, screens, mesh, intermediate vertical members, solid panels, and equivalent structural members shall be capable of withstanding, without failure, a force of at least 150 pounds (666 N) applied in any downward or outward direction at any point along the midrail or other member.		✓	(ii) Screens shall be of such construction and mounting that they are capable of withstanding a load of at least 200 pounds applied horizontally at any point on the near side of the screen. They may be of solid construction of grill work with openings not more than 8 inches long, or of slat work with openings not more than 4 inches wide with length unrestricted.
1926.502(b)(6)			
Guardrail systems shall be so surfaced as to prevent injury to an employee from punctures or lacerations, and to prevent snagging of clothing.	(c) Wooden toprailings shall be smooth and of 2-inch by 4-inch or larger material. Double, 1-inch by 4-inch members may be used for this purpose, provided that one member is fastened in a flat position on top of the posts and the other fastened in an edge-up position to the inside of the posts and the side of the top member. Midrails shall be of at least 1-inch by 6-inch material.	✓	✓
1926.502(b)(7)			
The ends of all top rails and midrails shall not overhang the terminal posts, except where such overhang does not constitute a projection hazard.	✓	✓	✓
1926.502(b)(8)			
Steel banding and plastic banding shall not be used as top rails or midrails.		✓	✓

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1926.502(b)(9)			
Top rails and midrails shall be at least one-quarter inch (0.6 cm) nominal diameter or thickness to prevent cuts and lacerations. If wire rope is used for top rails, it shall be flagged at not more than 6-foot intervals with high-visibility material.		✓	(iv) For wire rope railings, the top and intermediate railings shall be at least 1/2 inch fibre core rope, or the equivalent to meet strength factor and deflection of (b)(v) of this subsection. Posts shall be spaced not more than 8 feet on centers. The rope shall be stretched taut, so as to present a minimum deflection.
..1926.502(b)(10)			
1926.502(b)(10)			
When guardrail systems are used at hoisting areas, a chain, gate or removable guardrail section shall be placed across the access opening between guardrail sections when hoisting operations are not taking place.		✓	
1926.502(b)(11)			
When guardrail systems are used at holes, they shall be erected on all unprotected sides or edges of the hole.	✓	✓	
1926.502(b)(12)			
When guardrail systems are used around holes used for the passage of materials, the hole shall have not more than two sides provided with removable guardrail sections to allow the passage of materials. When the hole is not in use, it shall be closed over with a cover, or a guardrail system shall be provided along all unprotected sides or edges.	✓	✓	
1926.502(b)(13)			
When guardrail systems are used around holes which are used as points of access (such as ladderways), they shall be provided with a gate, or be so offset that a person cannot walk directly into the hole.	✓	✓	
1926.502(b)(14)			
Guardrail systems used on ramps and runways shall be erected along each unprotected side or edge.	✓	✓	✓
1926.502(b)(15)			
Manila, plastic or synthetic rope being used for top rails or midrails shall be inspected as frequently as necessary to ensure that it continues to meet the strength requirements of paragraph (b)(3) of this section.		✓	
..1926.502(c)			

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1926.502(c)	**§1671. Safety Nets.**		**WAC 296-24510 (b) Safety Net systems.**
"Safety net systems." Safety net systems and their use shall comply with the following provisions:			
1926.502(c)(1)			
Safety nets shall be installed as close as practicable under the walking/working surface on which employees are working, but in no case more than 30 feet (9.1 m) below such level. When nets are used on bridges, the potential fall area from the walking/working surface to the net shall be unobstructed.	(a) Where the elevation is 25 feet or more above the ground, water surface, or continuous floor level below, and when the use of personal fall arrest systems, personal fall restraint systems, positioning device systems or more conventional types of protection are clearly impractical, the exterior and/or interior perimeter of the structure shall be provided with an approved safety net extending at least 8 feet horizontally from such perimeter and being positioned at a distance not to exceed 10 feet vertically below where such hazards exist, or equivalent protection provided safety nets shall extend outward from the outermost projection of the work surface	✓	✓
1926.502(c)(2)			
Safety nets shall extend outward from the outermost projection of the work surface as follows:	✓	✓	✓
Vertical distance from working levels to horizontal plan of net. & Minimum required horizontal distance of outer edge of net from the edge of the working surface.			
Vertical Dist.: Up to 5 Feet - Minimum required horizontal dist.: 8 Feet	✓	✓	✓
Vertical Dist.: > 5' ≤ 10' - Minimum required horizontal dist.: 10 Feet	✓	✓	✓
Vertical Dist.: > 10' - Minimum required horizontal dist.: 13 Feet	✓	✓	✓
1926.502(c)(3)			
Safety nets shall be installed with sufficient clearance under them to prevent contact with the surface or structures below when subjected to an impact force equal to the drop test specified in paragraph (c)(4) of this section.	Nets shall be hung with sufficient clearance to prevent user's contact with the surfaces or structures below. Such clearances shall be determined by impact load testing.	✓	✓
1926.502(c)(4)			
Safety nets and their installations shall be capable of absorbing an impact force equal to that produced by the drop test specified in paragraph (c)(4)(i) of this section.		✓	✓
..1926.502(c)(4)(i)			

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1926.502(c)(4)(i)			
Except as provided in paragraph (c)(4)(ii) of this section, safety nets and safety net installations shall be drop-tested at the jobsite after initial installation and before being used as a fall protection system, whenever relocated, after major repair, and at 6-month intervals if left in one place. The drop-test shall consist of a 400 pound (180 kg) bag of sand 30 + or - 2 inches (76 + or - 5 cm) in diameter dropped into the net from the highest walking/working surface at which employees are exposed to fall hazards, but not from less than 42 inches (1.1 m) above that level.		✓	✓
1926.502(c)(4)(ii)			
When the employer can demonstrate that it is unreasonable to perform the drop-test required by paragraph (c)(4)(i) of this section, the employer (or a designated competent person) shall certify that the net and net installation is in compliance with the provisions of paragraphs (c)(3) and (c)(4)(i) of this section by preparing a certification record prior to the net being used as a fall protection system. The certification record must include an identification of the net and net installation for which the certification record is being prepared; the date that it was determined that the identified net and net installation were in compliance with paragraph (c)(3) of this section and the signature of the person making the determination and certification. The most recent certification record for each net and net installation shall be available at the jobsite for inspection.		✓	✓
1926.502(c)(5)			
Defective nets shall not be used. Safety nets shall be inspected at least once a week for wear, damage, and other deterioration. Defective components shall be removed from service. Safety nets shall also be inspected after any occurrence which could affect the integrity of the safety net system.		✓	✓
	EXCEPTION: See Section 1710 (d), (e) and (f) for flooring requirements and nets for steel erection in tiered buildings and structures.		
	(b) Only one level of nets shall be required for bridge construction.		
	(c) Safety nets purchased on or after January 1, 1998 shall be labeled as meeting the requirements of American National Standards Institute (ANSI) A10.11-1989, American National Standard for Construction and Demolition Operations - Personnel and Debris Nets, Repair and Demolition Operations. Safety nets purchased before January 1, 1998 shall be labeled as meeting the requirements of ANSI A10.11-1979, Safety Nets Used During Construction, Repair and Demolition Operations, or ANSI A10.11-1989.		

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..1926.502(c)(6)			
1926.502(c)(6)			
Materials, scrap pieces, equipment, and tools which have fallen into the safety net shall be removed as soon as possible from the net and at least before the next work shift.		✓	✓
1926.502(c)(7)			
The maximum size of each safety net mesh opening shall not exceed 36 square inches (230 cm) nor be longer than 6 inches (15 cm) on any side, and the opening, measured center-to-center of mesh ropes or webbing, shall not be longer than 6 inches (15 cm). All mesh crossings shall be secured to prevent enlargement of the mesh opening.		✓	✓
1926.502(c)(8)			
Each safety net (or section of it) shall have a border rope for webbing with a minimum breaking strength of 5,000 pounds (22.2 kN).		✓	✓
1926.502(c)(9)			
Connections between safety net panels shall be as strong as integral net components and shall be spaced not more than 6 inches (15 cm) apart.		✓	✓
			(c) Catch platforms.
			(i) A catch platform shall be installed within 10 vertical feet of the work area.
			(ii) The catch platforms width shall equal the distance of the fall but shall be a minimum of 45 inches wide and shall be equipped with standard guardrails on all open
1926.502(d)			**WAC 296-155-24510**(2) Fall arrest protection shall consist of:
"Personal fall arrest systems." Personal fall arrest systems and their use shall comply with the provisions set forth below. Effective January 1, 1998, body belts are not acceptable as part of a personal fall arrest system. Note: The use of a body belt in a positioning device system is acceptable and is regulated under paragraph (e) of this section.	✓	✓	
			(a) Full body harness system.
			(i) An approved Class III full body harness shall be used.
			(ii) Body harness systems or components subject to impact loading shall be immediately removed from service and shall not be used again for employee protection unless inspected and determined by a competent person to be undamaged and suitable for reuse.

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			(iv) The attachment point of the body harness shall be located in the center of the wearer's back near shoulder level, or above the wearer's head.
			(v) Body harness systems shall be rigged to minimize free fall distance with a maximum free fall distance allowed of 6 feet, and such that the employee will not contact any lower level.
			(ix) Full body harness systems shall be secured to anchorages capable of supporting 5,000 pounds per employee except: When self retracting lifelines or other deceleration devices are used which limit free fall to two feet, anchorages shall be capable of withstanding 3,000 pounds.
1926.502(d)(1)			
Connectors shall be drop forged, pressed or formed steel, or made of equivalent materials.	✓ The Standard does not say this but refers to equipment meeting requirements of ANSI A10.14-1991 or ANSI Z359.1-1992.	✓	✓
..1926.502(d)(2)			
1926.502(d)(2)			
Connectors shall have a corrosion-resistant finish, and all surfaces and edges shall be smooth to prevent damage to interfacing parts of the system.	✓ The Standard does not say this but refers to equipment meeting requirements of ANSI A10.14-1991 or ANSI Z359.1-1992.	✓	✓

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1926.502(d)(3)			
Dee-rings and snaphooks shall have a minimum tensile strength of 5,000 pounds (22.2 kN).	✓ The Standard does not say this but refers to equipment meeting requirements of ANSI A10.14-1991 or ANSI Z359.1-1992.	✓	(xiii) All components of body harness systems whose strength is not otherwise specified in this subsection shall be capable of supporting a minimum fall impact load of 5,000 pounds (22.2 kN) applied at the lanyard point of connection.
1926.502(d)(4)			
Dee-rings and snaphooks shall be proof-tested to a minimum tensile load of 3,600 pounds (16 kN) without cracking, breaking, or taking permanent deformation.	✓ The Standard does not say this but refers to equipment meeting requirements of ANSI A10.14-1991 or ANSI Z359.1-1992.	✓	✓
1926.502(d)(5)			
Snaphooks shall be sized to be compatible with the member to which they are connected to prevent unintentional disengagement of the snaphook by depression of the snaphook keeper by the connected member, or shall be a locking type snaphook designed and used to prevent disengagement of the snaphook by the contact of the snaphook keeper by the connected member. Effective January 1, 1998, only locking type snaphooks shall be used.	✓ The Standard does not say this but refers to equipment meeting requirements of ANSI A10.14-1991 or ANSI Z359.1-1992.	✓	(xv) Snap-hooks shall be a locking type snap-hook designed and used to prevent disengagement of the snap-hook by the contact of the snap-hook keeper by the connected member.
1926.502(d)(6)			
Unless the snaphook is a locking type and designed for the following connections, snaphooks shall not be engaged:	✓ The Standard does not say this but refers to equipment meeting requirements of ANSI A10.14-1991 or ANSI Z359.1-1992.	✓	✓
1926.502(d)(6)(i)			
directly to webbing, rope or wire rope;	✓ The Standard does not say this but refers to equipment meeting requirements of ANSI A10.14-1991 or ANSI Z359.1-1992.	✓	✓
1926.502(d)(6)(ii)			
to each other;	✓ The Standard does not say this but refers to equipment meeting requirements of ANSI A10.14-1991 or ANSI Z359.1-1992.	✓	✓
..1926.502(d)(6)(iii)			
1926.502(d)(6)(iii)			
to a dee-ring to which another snaphook or other connector is attached;	✓ The Standard does not say this but refers to equipment meeting requirements of ANSI A10.14-1991 or ANSI Z359.1-1992.	✓	✓
1926.502(d)(6)(iv)			
to a horizontal lifeline; or	✓ The Standard does not say this but refers to equipment meeting requirements of ANSI A10.14-1991 or ANSI Z359.1-1992.	✓	✓
1926.502(d)(6)(v)			
to any object which is incompatibly shaped or dimensioned in relation to the snaphook such that unintentional disengagement could occur by the connected object being able to depress the snaphook keeper and release itself.		✓	✓
1926.502(d)(7)			

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On suspended scaffolds or similar work platforms with horizontal lifelines which may become vertical lifelines, the devices used to connect to a horizontal lifeline shall be capable of locking in both directions on the lifeline.	✓	✓	
1926.502(d)(8)			
Horizontal lifelines shall be designed, installed, and used, under the supervision of a qualified person, as part of a complete personal fall arrest system, which maintains a safety factor of at least two.	✓	✓	✓
1926.502(d)(9)			
Lanyards and vertical lifelines shall have a minimum breaking strength of 5,000 pounds (22.2 kN).	✓	✓	(x) Vertical lifelines (droplines) shall have a minimum tensile strength of 5,000 pounds (22.2 kN), except that self retracting lifelines and lanyards which automatically limit free fall distance to two feet (.61 m) or less shall have a minimum tensile strength of 3,000 pounds (13.3 kN). (xii) Lanyards shall have a minimum tensile strength of 5,000 pounds (22.2 kN).
..1926.502(d)(10)			
1926.502(d)(10)			
1926.502(d)(10)(i)			
Except as provided in paragraph (d)(10)(ii) of this section, when vertical lifelines are used, each employee shall be attached to a separate lifeline.	✓	✓	✓
1926.502(d)(10)(ii)			
During the construction of elevator shafts, two employees may be attached to the same lifeline in the hoistway, provided both employees are working atop a false car that is equipped with guardrails; the strength of the lifeline is 10,000 pounds [5,000 pounds per employee attached] (44.4 kN); and all other criteria specified in this paragraph for lifelines have been met.	✓	✓	
1926.502(d)(11)			
Lifelines shall be protected against being cut or abraded.	✓	✓	✓
1926.502(d)(12)			
Self-retracting lifelines and lanyards which automatically limit free fall distance to 2 feet (0.61 m) or less shall be capable of sustaining a minimum tensile load of 3,000 pounds (13.3 kN) applied to the device with the lifeline or lanyard in the fully extended position.	✓	✓	✓
1926.502(d)(13)			
Self-retracting lifelines and lanyards which do not limit free fall distance to 2 feet (0.61 m) or less, ripstitch lanyards, and tearing and deforming lanyards shall be capable of sustaining a minimum tensile load of 5,000 pounds (22.2 kN) applied to the device with the lifeline or lanyard in the fully extended position.	✓	✓	

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..1926.502(d)(14)			
1926.502(d)(14)			
Ropes and straps (webbing) used in lanyards, lifelines, and strength components of body belts and body harnesses shall be made from synthetic fibers.	✓	✓	✓
1926.502(d)(15)			
Anchorages used for attachment of personal fall arrest equipment shall be independent of any anchorage being used to support or suspend platforms and capable of supporting at least 5,000 pounds (22.2 kN) per employee attached, or shall be designed, installed, and used as follows:	✓	✓	✓
1926.502(d)(15)(i)			
as part of a complete personal fall arrest system which maintains a safety factor of at least two; and	✓	✓	✓
1926.502(d)(15)(ii)			
under the supervision of a qualified person.	✓	✓	✓
1926.502(d)(16)			**WAC 296-155-24510 (2) Fall arrest protection shall cons**
Personal fall arrest systems, when stopping a fall, shall:			
1926.502(d)(16)(i)			
limit maximum arresting force on an employee to 900 pounds (4 kN) when used with a body belt;	✓	✓	✓ ANSI Standard Prior to 2005
1926.502(d)(16)(ii)			
limit maximum arresting force on an employee to 1,800 pounds (8 kN) when used with a body harness;	✓	✓	✓ ANSI Standard Prior to 2005
1926.502(d)(16)(iii)			
be rigged such that an employee can neither free fall more than 6 feet (1.8 m), nor contact any lower level;	be rigged such that an employee can neither free fall more than 4 feet, nor contact any lower level, and, where practicable, the anchor end of the lanyard shall be secured at a level not lower than the employee's waist;	✓	(vii) Restraint protection shall be rigged to allow the movement of employees only as far as the sides and edges of the walking/working surface.
..1926.502(d)(16)(iv)			
1926.502(d)(16)(iv)			
bring an employee to a complete stop and limit maximum deceleration distance an employee travels to 3.5 feet (1.07 m); and,	✓	✓	
1926.502(d)(16)(v)			
have sufficient strength to withstand twice the potential impact energy of an employee free falling a distance of 6 feet (1.8 m), or the free fall distance permitted by the system, whichever is less.	✓	✓	

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Note: If the personal fall arrest system meets the criteria and protocols contained in Appendix C to subpart M, and if the system is being used by an employee having a combined person and tool weight of less than 310 pounds (140 kg), the system will be considered to be in compliance with the provisions of paragraph (d)(16) of this section. If the system is used by an employee having a combined tool and body weight of 310 pounds (140 kg) or more, then the employer must appropriately modify the criteria and protocols of the Appendix to provide proper protection for such heavier weights, or the system will not be deemed to be in compliance with the requirements of paragraph (d)(16) of this section.	✓	✓	Note: The system strength needs in the following items are based on a total combined weight of employee and tools of no more than 310 pounds. If combined weight is more than 310 pounds, appropriate allowances must be made or the system will not be deemed to be in compliance.
1926.502(d)(17)			
The attachment point of the body belt shall be located in the center of the wearer's back. The attachment point of the body harness shall be located in the center of the wearer's back near shoulder level, or above the wearer's	✓	✓	✓
1926.502(d)(18)			
Body belts, harnesses, and components shall be used only for employee protection (as part of a personal fall arrest system or positioning device system) and not to hoist materials.	✓	✓	✓
1926.502(d)(19)			
Personal fall arrest systems and components subjected to impact loading shall be immediately removed from service and shall not be used again for employee protection until inspected and determined by a competent person to be undamaged and suitable for reuse.	✓	✓	✓
1926.502(d)(20)			
The employer shall provide for prompt rescue of employees in the event of a fall or shall assure that employees are able to rescue themselves.	✓	✓	
..1926.502(d)(21)			
1926.502(d)(21)			
Personal fall arrest systems shall be inspected prior to each use for wear, damage and other deterioration, and defective components shall be removed from service.	✓	✓	(xvii) Full body harness systems shall be inspected prior to each use for mildew, wear, damage, and other deterioration, and defective components shall be removed from service if their function or strength have been adversely affected.
1926.502(d)(22)	See #19 of CA OSAH		
Body belts shall be at least one and five-eighths (1 5/8) inches (4.1 cm) wide.	✓	✓	✓ ANSI Standard Prior to 2005

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1926.502(d)(23)			
Personal fall arrest systems shall not be attached to guardrail systems, nor shall they be attached to hoists except as specified in other subparts of this Part.	✓	✓	
1926.502(d)(24)			
When a personal fall arrest system is used at hoist areas, it shall be rigged to allow the movement of the employee only as far as the edge of the walking/working surface.	✓	✓	
	Each personal fall arrest system shall be inspected not less than twice annually by a competent person in accordance with the manufacturer's recommendations. The date of inspection shall be documented.		
		437-003-0502	
		437-003-0502 Personal Fall Restraint. Fall restraint systems and their use shall conform to the following provisions:	
		(1) Personal fall restraint systems shall be rigged to prevent the user from falling any distance.	
		(2) Fall restraint systems must use fall arrest system components that conform to the criteria in 1926.502, except as otherwise provided for in this section.	
		Exception: A body belt may be used in fall restraint systems.	
		(3) The attachment point to the body belt or full body harness may be at the back, front or side dee-rings.	
		(4) Anchorages used for attachment of personal fall restraint equipment shall be independent of any anchorage being used to support or suspend platforms and shall be capable of supporting 3000 pounds (13.3kN) per employee attached, or be designed, installed and used as follows:	
		(a) as part of a complete personal fall restraint system which maintains a safety factor of at least two; and	
		(b) under the supervision of a qualified person.	
1926.502(e)			**WAC 296-155-24510(3) Positioning device systems.** Positioning device systems and their use shall conform to the following provisions:
"Positioning device systems." Positioning device systems and their use shall conform to the following provisions:	✓		
1926.502(e)(1)			
Positioning devices shall be rigged such that an employee cannot free fall more than 2 feet (.9 m).	✓	✓	✓
1926.502(e)(2)			
Positioning devices shall be secured to an anchorage capable of supporting at least twice the potential impact load of an employee's fall or 3,000 pounds (13.3 kN), whichever is greater.	✓	✓	(vi) Anchorage points used for fall restraint shall be capable of supporting 4 times the intended load.

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1926.502(e)(3)			
Connectors shall be drop forged, pressed or formed steel, or made of equivalent materials.	✓ The Standard does not say this but refers to equipment meeting requirements of ANSI A10.14-1991 or ANSI Z359.1-1992.	✓	✓
..1926.502(e)(4)			
1926.502(e)(4)			
Connectors shall have a corrosion-resistant finish, and all surfaces and edges shall be smooth to prevent damage to interfacing parts of this system.	✓ The Standard does not say this but refers to equipment meeting requirements of ANSI A10.14-1991 or ANSI Z359.1-1992.	✓	✓
1926.502(e)(5)			
Connecting assemblies shall have a minimum tensile strength of 5,000 pounds (22.2 kN)	✓ The Standard does not say this but refers to equipment meeting requirements of ANSI A10.14-1991 or ANSI Z359.1-1992.	✓	✓
1926.502(e)(6)			
Dee-rings and snaphooks shall be proof-tested to a minimum tensile load of 3,600 pounds (16 kN) without cracking, breaking, or taking permanent deformation.	✓ The Standard does not say this but refers to equipment meeting requirements of ANSI A10.14-1991 or ANSI Z359.1-1992.	✓	✓
1926.502(e)(7)			
Snaphooks shall be sized to be compatible with the member to which they are connected to prevent unintentional disengagement of the snaphook by depression of the snaphook keeper by the connected member, or shall be a locking type snaphook designed and used to prevent disengagement of the snaphook by the contact of the snaphook keeper by the connected member. As of January 1, 1998, only locking type snaphooks shall be used.	The use of non-locking snaphooks shall be prohibited after January 1, 1998.	✓	(g) Snap-hooks shall be a locking type snap-hook designed and used to prevent disengagement of the snap-hook by the contact of the snap-hook keeper by the connected member.
1926.502(e)(8)			
Unless the snaphook is a locking type and designed for the following connections, snaphooks shall not be engaged:	✓ The Standard does not say this but refers to equipment meeting requirements of ANSI A10.14-1991 or ANSI Z359.1-1992.	✓	✓
1926.502(e)(8)(i)			
directly to webbing, rope or wire rope;	✓ The Standard does not say this but refers to equipment meeting requirements of ANSI A10.14-1991 or ANSI Z359.1-1992.	✓	✓
1926.502(e)(8)(ii)			
to each other;	✓ The Standard does not say this but refers to equipment meeting requirements of ANSI A10.14-1991 or ANSI Z359.1-1992.	✓	✓
..1926.502(e)(8)(iii)			
1926.502(e)(8)(iii)			
to a dee-ring to which another snaphook or other connector is attached;	✓ The Standard does not say this but refers to equipment meeting requirements of ANSI A10.14-1991 or ANSI Z359.1-1992.	✓	✓

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1926.502(e)(8)(iv)			
to a horizontal lifeline; or	✓ The Standard does not say this but refers to equipment meeting requirements of ANSI A10.14-1991 or ANSI Z359.1-1992.	✓	✓
1926.502(e)(8)(v)			
to any object which is incompatibly shaped or dimensioned in relation to the snaphook such that unintentional disengagement could occur by the connected object being able to depress the snaphook keeper and release itself.	✓ The Standard does not say this but refers to equipment meeting requirements of ANSI A10.14-1991 or ANSI Z359.1-1992.	✓	✓
1926.502(e)(9)			
Positioning device systems shall be inspected prior to each use for wear, damage, and other deterioration, and defective components shall be removed from service.	✓	✓	✓
1926.502(e)(10)			
Body belts, harnesses, and components shall be used only for employee protection (as part of a personal fall arrest system or positioning device system) and not to hoist materials.	✓	✓	✓
			(4) Droplines or lifelines used on rock scaling operations, or in areas where the lifeline may be subjected to cutting or abrasion, shall be a minimum of 7/8 inch wire core manila rope. For all other lifeline applications, a minimum of 3/4 inch manila or equivalent, with a minimum breaking strength of 5,000 pounds, shall be used.
			(5) Safety harnesses, lanyards, lifelines or droplines, independently attached or attended, shall be used while performing the following types of work when other equivalent type protection is not provided:
			(a) Work performed in permit required confined spaces and other confined spaces shall follow the procedures as described in chapter 296-62 WAC, Part M.
			(b) Work on hazardous slopes, or dismantling safety nets, working on poles or from boatswains chairs at elevations greater than six feet (1.83 m), swinging scaffolds or other unguarded locations.
			(c) Work on skips and platforms used in shafts by crews when the skip or cage does not occlude the opening to within one foot (30.5 cm) of the sides of the shaft, unless cages are provided.
			(6) Canopies, when used as falling object protection, shall be strong enough to prevent collapse and to prevent penetration by any objects which may fall onto the

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1926.502(f)		**437-003-1502 Warning Line Systems for Roofing Work.**	**WAC 296-155-24515(3) Warning line systems.**
"Warning line systems." Warning line systems [See 1926.501(b)(10)] and their use shall comply with the following provisions:			
		(1) Warning line systems shall not be used as fall protection on roof slopes greater than 2 in 12 (Vertical or Horizontal).	
		(2) Employees performing roofing work between a roof edge and a warning line must be protected by a personal fall arrest system, personal fall restraint system, guardrail system, safety net system, or safety monitoring system.	
1926.502(f)(1)			
The warning line shall be erected around all sides of the roof work area.		✓	✓
..1926.502(f)(1)(i)			
1926.502(f)(1)(i)			
When mechanical equipment is not being used, the warning line shall be erected not less than 6 feet (1.8 m) from the roof edge.		✓	✓
1926.502(f)(1)(ii)			
When mechanical equipment is being used, the warning line shall be erected not less than 6 feet (1.8 m) from the roof edge which is parallel to the direction of mechanical equipment operation, and not less than 10 feet (3.1 m) from the roof edge which is perpendicular to the direction of mechanical equipment operation.		✓	✓
			WAC 296-155-24515 Guarding of low pitched roof perimeters.
			(1) General provisions. During the performance of work on low pitched roofs with a potential fall hazard greater than 10 feet, the employer shall ensure that employees engaged in such work be protected from falling from all unprotected sides and edges of the roof as follows:
			(a) By the use of a fall restraint or fall arrest systems, as defined in WAC 296-155-24510; or
			(b) By the use of a warning line system erected and maintained as provided in subsection (3) of this section and supplemented for employees working between the warning line and the roof edge by the use of a safety monitor system as described in WAC 296-155-24521.
			(c) Mechanical equipment shall be used or stored only in areas where employees are protected by a warning line system, or fall restraint, or fall arrest systems as described in WAC 296-155-24510.
			Mechanical equipment may not be used or stored where the only protection is provided by the use of a safety monitor.

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			(2) Exceptions.
			(a) The provisions of subsection (1)(a) of this section do not apply at points of access such as stairways, ladders, and ramps, or when employees are on the roof only to inspect, investigate, or estimate roof level conditions. Roof edge materials handling areas and materials storage areas shall be guarded as provided in subsection (4) of this section.
			(b) Employees engaged in roofing on low-pitched roofs less than 50 feet wide, may elect to use a safety monitor system without warning lines.
1926.502(f)(1)(iii)			**WAC 296-155-24515(3)(c)(i)(ii)**
Points of access, materials handling areas, storage areas, and hoisting areas shall be connected to the work area by an access path formed by two warning lines.	✓	✓	✓
1926.502(f)(1)(iv)			
When the path to a point of access is not in use, a rope, wire, chain, or other barricade, equivalent in strength and height to the warning line, shall be placed across the path at the point where the path intersects the warning line erected around the work area, or the path shall be offset such that a person cannot walk directly into the work	✓	✓	✓
1926.502(f)(2)			
Warning lines shall consist of ropes, wires, or chains, and supporting stanchions erected as follows:	✓	✓	✓
1926.502(f)(2)(i)			
The rope, wire, or chain shall be flagged at not more than 6-foot (1.8 m) intervals with high-visibility material;	✓	✓	✓
..1926.502(f)(2)(ii)			
1926.502(f)(2)(ii)			
The rope, wire, or chain shall be rigged and supported in such a way that its lowest point (including sag) is no less than 34 inches (.9 m) from the walking/working surface and its highest point is no more than 39 inches (1.0 m) from the walking/working surface;	(2) Warning lines consisting of rope, wire or similar material, flagged with highly visible material hanging from the warning lines at approximately 6-foot intervals, shall be installed 34 to 45 inches above the roof surface to warn employees that they are approaching the edge of the roof.	✓	(ii) The rope, wire, or chain shall be rigged and supported in such a way that its lowest point (including sag) is no less than 36 inches (91.4 cm) from the roof surface and its highest point is no more than 42 inches (106.7 cm) from the roof surface.
1926.502(f)(2)(iii)			
After being erected, with the rope, wire, or chain attached, stanchions shall be capable of resisting, without tipping over, a force of at least 16 pounds (71 N) applied horizontally against the stanchion, 30 inches (.8 m) above the walking/working surface, perpendicular to the warning line, and in the direction of the floor, roof, or platform edge;		✓	✓

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1926.502(f)(2)(iv)			
The rope, wire, or chain shall have a minimum tensile strength of 500 pounds (2.22 kN), and after being attached to the stanchions, shall be capable of supporting, without breaking, the loads applied to the stanchions as prescribed in paragraph (f)(2)(iii) of this section; and	(B) Warning lines shall have a minimum tensile strength of 500 pounds.	✓	(iv) The rope, wire, or chain shall have a minimum tensile strength of 200 pounds (90 kilograms), and after being attached to the stanchions, shall be capable of supporting, without breaking, the loads applied to the stanchions.
1926.502(f)(2)(v)			
The line shall be attached at each stanchion in such a way that pulling on one section of the line between stanchions will not result in slack being taken up in adjacent sections before the stanchion tips over.	✓	✓	✓
1926.502(f)(3)			
No employee shall be allowed in the area between a roof edge and a warning line unless the employee is performing roofing work in that area.		✓	
..1926.502(f)(4)			
1926.502(f)(4)			
Mechanical equipment on roofs shall be used or stored only in areas where employees are protected by a warning line system, guardrail system, or personal fall arrest system.		✓	
			WAC 296-155-24515 (4) Roof edge materials handling areas and meterials storage.
			(4) Roof edge materials handling areas and materials storage. Employees working in a roof edge materials handling or materials storage area located on a low pitched roof with a ground to eave height greater than 10 feet shall be protected from falling along all unprotected roof sides and edges of the area.
			(a) When guardrails are used at hoisting areas, a minimum of four feet of guardrail shall be erected on each side of the access point through which materials are hoisted.
			(b) A chain or gate shall be placed across the opening between the guardrail sections when hoisting operations are not taking place.
			(c) When guardrails are used at bitumen pipe outlet, a minimum of four feet of guardrail shall be erected on each side of the pipe.
			(d) When safety belt/harness systems are used, they shall not be attached to the hoist.
			(e) When fall restraint systems are used, they shall be rigged to allow the movement of employees only as far as the roof edge.
			(f) Materials shall not be stored within six feet of the roof edge unless guardrails are erected at the roof edge.

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1926.502(g)	**§1671.2. Controlled Access Zones and Safety Monitoring Systems.**	NOTE: §1926.502(g) and (h) were repealed. In Oregon, 437-003-2502 applies.	**WAC 296-155-24520 Leading edge control zone.**
"Controlled access zones." Controlled access zones [See 1926.501(b)(9) and 1926.502(k)] and their use shall conform to the following provisions.	(1) When performing leading edge work, the employer shall ensure that a control zone be established according to the following requirements:	NOTE: §1926.502(g) and (h) were repealed. In Oregon, 437-003-2502 applies.	(1) When performing leading dege work, the employer shall ensure that a control zone be established according to the following requirements:
1926.502(g)(1)	(a) Controlled access zones.		
When used to control access to areas where leading edge and other operations are taking place the controlled access zone shall be defined by a control line or by any other means that restricts access.	(1) When used to control access to areas where leading edge and other operations are taking place, the controlled access zone shall be defined by a control line or by any other means that restricts access. **Signs shall be posted to warn unauthorized employees to stay out of the controlled access zone.**	NOTE: §1926.502(g) and (h) were repealed. In Oregon, 437-003-2502 applies.	(a) The control zone shall begin a minimum of 6 feet back from the leading edge to prevent exposure by employees who are not protected by fall restraint or fall arrest systems.
1926.502(g)(1)(i)			
When control lines are used, they shall be erected not less than 6 feet (1.8 m) nor more than 25 feet (7.7 m) from the unprotected or leading edge, except when erecting precast concrete members.	(1) When used to control access to areas where leading edge and other operations are taking place, the controlled access zone shall be defined by a control line or by any other means that restricts access. Signs shall be posted to warn unauthorized employees to stay out of the controlled access zone.	NOTE: §1926.502(g) and (h) were repealed. In Oregon, 437-003-2502 applies.	(b) The control zone shall be separated from other areas of the low pitched roof or walking/working surface by the erection of a warning line system.
1926.502(g)(1)(ii)			
When erecting precast concrete members, the control line shall be erected not less than 6 feet (1.8 m) nor more than 60 feet (18 m) or half the length of the member being erected, whichever is less, from the leading edge.	✓	NOTE: §1926.502(g) and (h) were repealed. In Oregon, 437-003-2502 applies.	(c) The warning line system shall consist of wire, rope, or chain supported on stanchions, or a method which provides equivalent protection.
1926.502(g)(1)(iii)			
The control line shall extend along the entire length of the unprotected or leading edge and shall be approximately parallel to the unprotected or leading edge.	✓	NOTE: §1926.502(g) and (h) were repealed. In Oregon, 437-003-2502 applies.	(d) The spacing of the stanchions and support of the line shall be such that the lowest point of the line (including sag) is not less than 36 inches from the walking/working surface, and its highest point is not more than 42 inches (106.7 cm) from the walking/working surface.
..1926.502(g)(1)(iv)			
1926.502(g)(1)(iv)			
The control line shall be connected on each side to a guardrail system or wall.	(5) The control line shall be connected on each side to a standard railing or wall, or securely anchored on each end.	NOTE: §1926.502(g) and (h) were repealed. In Oregon, 437-003-2502 applies.	(e) Each line shall have a minimum tensile strength of 200 pounds (90 kilograms).
1926.502(g)(2)			
When used to control access to areas where overhand bricklaying and related work are taking place:		NOTE: §1926.502(g) and (h) were repealed. In Oregon, 437-003-2502 applies.	(f) Each line shall be flagged or clearly marked with high visibility materials at intervals not to exceed 6 feet.
1926.502(g)(2)(i)			
The controlled access zone shall be defined by a control line erected not less than 10 feet (3.1 m) nor more than 15 feet (4.5 m) from the working edge.		NOTE: §1926.502(g) and (h) were repealed. In Oregon, 437-003-2502 applies.	(g) After being erected with the rope, or chain attached, stanchions shall be capable of resisting without tipping over, a force of at least 16 pounds (71 Newtons) applied horizontally against the stanchions 30 inches (0.76 meters) above the roof surface, perpendicular to the warning line and in the direction of the roof edge.

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1926.502(g)(2)(ii)			
The control line shall extend for a distance sufficient for the controlled access zone to enclose all employees performing overhand bricklaying and related work at the working edge and shall be approximately parallel to the working edge.		NOTE: §1926.502(g) and (h) were repealed. In Oregon, 437-003-2502 applies.	(2) When positive means of fall restraint as described in WAC 296-155-24510 (1)(a) through (d), or fall arrest as described in WAC 296-155-24510 (2) through (6) are not utilized, a safety monitor system as described in WAC 296-155-24521 shall be implemented to protect employees working between the forward edge of the warning line and the leading edge.
1926.502(g)(2)(iii)			
Additional control lines shall be erected at each end to enclose the controlled access zone.		NOTE: §1926.502(g) and (h) were repealed. In Oregon, 437-003-2502 applies.	
1926.502(g)(2)(iv)			
Only employees engaged in overhand bricklaying or related work shall be permitted in the controlled access zone.		NOTE: §1926.502(g) and (h) were repealed. In Oregon, 437-003-2502 applies.	
1926.502(g)(3)			
Control lines shall consist of ropes, wires, tapes, or equivalent materials, and supporting stanchions as follows:	(6) Control lines shall consist of ropes, wires, tapes, or equivalent materials, and supporting stanchions as follows:	NOTE: §1926.502(g) and (h) were repealed. In Oregon, 437-003-2502 applies.	
1926.502(g)(3)(i)			
Each line shall be flagged or otherwise clearly marked at not more than 6-foot (1.8 m) intervals with high-visibility material.	✓	NOTE: §1926.502(g) and (h) were repealed. In Oregon, 437-003-2502 applies.	✓
..1926.502(g)(3)(ii)			
1926.502(g)(3)(ii)			
Each line shall be rigged and supported in such a way that its lowest point (including sag) is not less than 39 inches (1 m) from the walking/working surface and its highest point is not more than 45 inches (1.3 m) [50 inches (1.3 m) when overhand bricklaying operations are being performed] from the walking/working surface.	(B) Each line shall be rigged and supported in such a way that its lowest point (including sag) is not less than 39 inches from the working level/working area and its highest point is not more than 45 inches.	NOTE: §1926.502(g) and (h) were repealed. In Oregon, 437-003-2502 applies.	
1926.502(g)(3)(iii)			
Each line shall have a minimum breaking strength of 200 pounds (.88 kN).	✓	NOTE: §1926.502(g) and (h) were repealed. In Oregon, 437-003-2502 applies.	✓
1926.502(g)(4)			
On floors and roofs where guardrail systems are not in place prior to the beginning of overhand bricklaying operations, controlled access zones shall be enlarged, as necessary, to enclose all points of access, material handling areas, and storage areas.		NOTE: §1926.502(g) and (h) were repealed. In Oregon, 437-003-2502 applies.	
1926.502(g)(5)			
On floors and roofs where guardrail systems are in place, but need to be removed to allow overhand bricklaying work or leading edge work to take place, only that portion of the guardrail necessary to accomplish that day's work shall be removed.		NOTE: §1926.502(g) and (h) were repealed. In Oregon, 437-003-2502 applies.	

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1926.502(h)	§1671.2.(b) Safety monitoring systems.		**WAC 296-155-24521 Safety monitor system**
"Safety monitoring systems." Safety monitoring systems [See 1926.501(b)(10) and 1926.502(k)] and their use shall comply with the following provisions:		437-003-2502 Safety monitoring systems. Safety monitoring systems for roofing work and their use shall comply with the following provisions.	(1) A safety monitor system (SMS) may be used in conjunction with a warning line system as a method of guarding against falls during work on low pitched roofs and leading edge work only.
		(1) A safety monitoring system shall not be used as a fall protection system for any work other than roofing work on roof slopes of 2 in 12 (vertical to horizontal) or less.	(2) When selected, the employer shall ensure that the safety monitor system shall be addressed in the fall protection work plan, include the name of the safety monitor(s) and the extent of their training in both the safety monitor and warning line systems, and shall ensure that the following requirements are met.
		(2) The use of a safety monitoring system alone (i.e., without the warning line system) is not permitted on roofs more than 50 feet (15.25 m) in width. (see Appendix A of this subdivision)	(3) The safety monitor system shall not be used when adverse weather conditions create additional hazards.
			(4) A person acting in the capacity of safety monitor(s) shall be trained in the function of both the safety monitor and warning lines systems, and shall:
			(b) Have control authority over the work as it relates to fall protection.
			(c) Be instantly distinguishable over members of the work crew.
			(d) Engage in no other duties while acting as safety monitor.
			(e) Be positioned in relation to the workers under their protection, so as to have a clear, unobstructed view and be able to maintain normal voice communication.
			(f) Not supervise more than eight exposed workers at one time.
1926.502(h)(1)			
The employer shall designate a competent person to monitor the safety of other employees and the employer shall ensure that the safety monitor complies with the following requirements:	✓	✓	(a) Be a competent person as defined in WAC 296-155-24503.
1926.502(h)(1)(i)			
The safety monitor shall be competent to recognize fall hazards;	✓	✓	✓
..1926.502(h)(1)(ii)			
1926.502(h)(1)(ii)			
The safety monitor shall warn the employee when it appears that the employee is unaware of a fall hazard or is acting in an unsafe manner;	✓	✓	✓

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1926.502(h)(1)(iii)			
The safety monitor shall be on the same walking/working surface and within visual sighting distance of the employee being monitored;	✓	✓	(e) Be positioned in relation to the workers under their protection, so as to have a clear, unobstructed view and be able to maintain normal voice communication.
			(5) Control zone:
			(a) Workers shall be distinguished from other members of the crew by wearing highly visible, distinctive, and uniform apparel readily distinguishing them from other members of the crew only while in the control zone.
			(b) The employer shall ensure that each employee working in a control zone promptly comply with fall hazard warnings from safety monitors.
1926.502(h)(1)(iv)			
The safety monitor shall be close enough to communicate orally with the employee; and	✓	✓	✓
1926.502(h)(1)(v)			
The safety monitor shall not have other responsibilities which could take the monitor's attention from the monitoring function.	✓	✓	✓
1926.502(h)(2)			
Mechanical equipment shall not be used or stored in areas where safety monitoring systems are being used to monitor employees engaged in roofing operations on low-slope roofs.		(4) Mechanical equipment shall not be used or stored in areas where safety monitoring systems are being used to monitor employees engaged in roofing operations.	
1926.502(h)(3)			
No employee, other than an employee engaged in roofing work [on low-sloped roofs] or an employee covered by a fall protection plan, shall be allowed in an area where an employee is being protected by a safety monitoring system.	(2) No employee, other than an employee **covered by a fall protection plan**, shall be allowed in an area where an employee is being protected by a safety monitoring system.	(5) No employee, other than an employee engaged in roofing work shall be allowed in an area where an employee is being protected by a safety monitoring system.	
1926.502(h)(4)			
Each employee working in a controlled access zone shall be directed to comply promptly with fall hazard warnings from safety monitors.	✓		✓
		437-003-3502 Slide Guard Systems.	
..1926.502(i)			
1926.502(i)			
"Covers." Covers for holes in floors, roofs, and other walking/working surfaces shall meet the following requirements:		✓	

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1926.502(i)(1)			
Covers located in roadways and vehicular aisles shall be capable of supporting, without failure, at least twice the maximum axle load of the largest vehicle expected to cross over the cover.		✓	(g) All floor opening or hole covers shall be capable of supporting the maximum potential load but never less than two hundred pounds (with a safety factor of four).
1926.502(i)(2)			
All other covers shall be capable of supporting, without failure, at least twice the weight of employees, equipment, and materials that may be imposed on the cover at any one time.		✓	
			(iii) If it becomes necessary to remove the cover, a monitor shall remain at the opening until the cover is replaced. The monitor shall advise persons entering the area of the hazard, shall prevent exposure to the fall hazard and shall perform no other duties.
1926.502(i)(3)			
All covers shall be secured when installed so as to prevent accidental displacement by the wind, equipment, or employees.		✓	✓
			(h) Floor holes, into which persons can accidentally walk, shall be guarded by either a standard railing with standard toe board on all exposed sides, or a floor hole cover of standard strength and construction that is secured against accidental displacement. While the cover is not in place, the floor hole shall be protected by a standard railing.
1926.502(i)(4)			
All covers shall be color coded or they shall be marked with the word "HOLE" or "COVER" to provide warning of the hazard.		✓	✓
Note: This provision does not apply to cast iron manhole covers or steel grates used on streets or roadways.		✓	
1926.502(j)			
"Protection from falling objects." Falling object protection shall comply with the following provisions:	✓	✓	
1926.502(j)(1)			
Toeboards, when used as falling object protection, shall be erected along the edge of the overhead walking/working surface for a distance sufficient to protect employees below.	✓	✓	
..1926.502(j)(2)			
1926.502(j)(2)			
Toeboards shall be capable of withstanding, without failure, a force of at least 50 pounds (222 N) applied in any downward or outward direction at any point along the toeboard.		✓	

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1926.502(j)(3)			
Toeboards shall be a minimum of 3 1/2 inches (9 cm) in vertical height from their top edge to the level of the walking/working surface. They shall have not more than 1/4 inch (0.6 cm) clearance above the walking/working surface. They shall be solid or have openings not over 1 inch (2.5 cm) in greatest dimension.	(b) A standard toeboard shall be 4 inches (nominal) minimum in vertical height from its top edge to the level of the floor, platform, runway, or ramp. It shall be securely fastened in place and have not more than 1/4-inch clearance above floor level. It may be made of any substantial material, either solid, or with openings not over one inch in greatest dimension. Toeboards shall be provided on all open sides and ends of railed scaffolds at locations where persons are required to work or pass under the scaffold and at all interior floor, roof, and shaft openings.	✓	(c) (i) A standard toe board shall be 4 inches minimum in vertical height from its top edge to the level of the floor, platform, runway, or ramp. It shall be securely fastened in place and have not more than 1/4 inch clearance above floor level. It may be made of any substantial material, either solid, or with openings not over 1 inch in greatest dimension.
1926.502(j)(4)			
Where tools, equipment, or materials are piled higher than the top edge of a toeboard, paneling or screening shall be erected from the walking/working surface or toeboard to the top of a guardrail system's top rail or midrail, for a distance sufficient to protect employees below.	(c) Where material is piled to such height that a standard toeboard does not provide protection, paneling or screening from floor to intermediate rail or top rail shall be provided. Where such paneling or screening extend to the toprail, midrails may be omitted.	✓	
1926.502(j)(5)			
Guardrail systems, when used as falling object protection, shall have all openings small enough to prevent passage of potential falling objects.		✓	
1926.502(j)(6)			
During the performance of overhand bricklaying and related work:		✓	
1926.502(j)(6)(i)			
No materials or equipment except masonry and mortar shall be stored within 4 feet (1.2 m) of the working edge.		✓	
..1926.502(j)(6)(ii)			
1926.502(j)(6)(ii)			
Excess mortar, broken or scattered masonry units, and all other materials and debris shall be kept clear from the work area by removal at regular intervals.		✓	
1926.502(j)(7)			
During the performance of roofing work:		✓	
1926.502(j)(7)(i)			
Materials and equipment shall not be stored within 6 feet (1.8 m) of a roof edge unless guardrails are erected at the edge.		✓	
1926.502(j)(7)(ii)			
Materials which are piled, grouped, or stacked near a roof edge shall be stable and self-supporting.		✓	
1926.502(j)(8)			
Canopies, when used as falling object protection, shall be strong enough to prevent collapse and to prevent penetration by any objects which may fall onto the		✓	

Federal OSHA 29 CFR 1926 - Fall Protection for Construction	State OSHA Fall Protection Standards		
	California	Oregon	Washington
19 CFR 1026.500 - 503	Article 2 - Definitions (1504/1505) Article 24 - Fall Protection (1669/1672)	ORS 654 DIV 3 (Construction) Subdivision M (Fall Protection)	Chapter 296-155 WAC Part C-1 Construction Work Fall Restraint & Fall Arrest
1926.502(k)	**§1671.1. Fall Protection Plan.**	NOTE: §1926.502(k) was repealed. In Oregon, 437-003-15	**WAC 296-155-24505 Fall protection work plan.**
"Fall protection plan." This option is available only to employees engaged in leading edge work, precast concrete erection work, or residential construction work (See 1926.501(b)(2), (b)(12), and (b)(13)) who can demonstrate that it is infeasible or it creates a greater hazard to use conventional fall protection equipment. The fall protection plan must conform to the following provisions.	(a) This section applies to all construction operations when it can be shown that the use of conventional fall protection is impractical or creates a greater hazard.	NOTE: §1926.502(k) was repealed. In Oregon, 437-003-15	(1) The employer shall develop and implement a written fall protection work plan including each area of the work place where the employees are assigned and where fall hazards of 10 feet or more exist.
			(2) The fall protection work plan shall:
1926.502(k)(1)			(a) Identify all fall hazards in the work area.
			(b) Describe the method of fall arrest or fall restraint to be provided.
The fall protection plan shall be prepared by a qualified person and developed specifically for the site where the leading edge work, precast concrete work, or residential construction work is being performed and the plan must be maintained up to date.	(1) The fall protection plan shall be prepared by a qualified person and developed specifically for the site where the construction work is being performed and the plan must be maintained up to date. The plan shall document the identity of the qualified person.	NOTE: §1926.502(k) was repealed. In Oregon, 437-003-15	(c) Describe the correct procedures for the assembly, maintenance, inspection, and disassembly of the fall protection system to be used.
	NOTE: The employer need only develop a single site fall protection plan for sites where the construction operations are essentially identical.		(d) Describe the correct procedures for the handling, storage, and securing of tools and materials.
..1926.502(k)(2)			Describe the method of providing overhead protection for workers who may be in, or pass through the area below
			(f) Describe the method for prompt, safe removal of injured workers.
1926.502(k)(2)			
Any changes to the fall protection plan shall be approved by a qualified person.	(2) Any changes to the fall protection plan shall be approved by a qualified person. The identity of the qualified person shall be documented.	NOTE: §1926.502(k) was repealed. In Oregon, 437-003-1501 applies.	
1926.502(k)(3)			
A copy of the fall protection plan with all approved changes shall be maintained at the job site.	(3) A copy of the fall protection plan with all approved changes shall be maintained at the job site.	NOTE: §1926.502(k) was repealed. In Oregon, 437-003-15	(g) Be available on the job site for inspection by the department.
			(3) Prior to permitting employees into areas where fall hazards exist the employer shall:
1926.502(k)(4)			(a) Ensure that employees are trained and instructed in the items described in subsection (2)(a) through (f) of this section.
			(b) Inspect fall protection devices and systems to ensure compliance with WAC 296-155-24510.
The implementation of the fall protection plan shall be under the supervision of a competent person.	(4) The implementation of the fall protection plan shall be under the supervision of a competent person. The plan shall document the identity of the competent person.	NOTE: §1926.502(k) was repealed. In Oregon, 437-003-1501 applies.	
1926.502(k)(5)			
The fall protection plan shall document the reasons why the use of conventional fall protection systems (guardrail systems, personal fall arrest systems, or safety nets systems) are infeasible or why their use would create a greater hazard.	(5) The fall protection plan shall document the reasons why the use of conventional fall protection systems (guardrails, personal fall arrest systems, or safety nets) are infeasible or why their use would create a greater hazard.	NOTE: §1926.502(k) was repealed. In Oregon, 437-003-1501 applies.	

Federal OSHA 29 CFR 1926 - Fall Protection for Construction	State OSHA Fall Protection Standards		
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1926.502(k)(6)			
The fall protection plan shall include a written discussion of other measures that will be taken to reduce or eliminate the fall hazard for workers who cannot be provided with protection from the conventional fall protection systems. For example, the employer shall discuss the extent to which scaffolds, ladders, or vehicle mounted work platforms can be used to provide a safer working surface and thereby reduce the hazard of falling.	(6) The fall protection plan shall include a written discussion of other measures that will be taken to reduce or eliminate the fall hazard for workers who cannot be provided with protection provided by conventional fall protection systems. For example, the employer shall discuss the extent to which scaffolds, ladders, or vehicle mounted work platforms can be used to provide a safer working surface and thereby reduce the hazard of falling.	NOTE: §1926.502(k) was repealed. In Oregon, 437-003-1501 applies.	
1926.502(k)(7)			
The fall protection plan shall identify each location where conventional fall protection methods cannot be used. These locations shall then be classified as controlled access zones and the employer must comply with the criteria in paragraph (g) of this section.	(7) The fall protection plan shall identify each location where conventional fall protection methods cannot be used. These locations shall then be classified as controlled access zones and the employer must comply with the criteria in Section 1671.2(a).	NOTE: §1926.502(k) was repealed. In Oregon, 437-003-1501 applies.	
..1926.502(k)(8)			
1926.502(k)(8)			
Where no other alternative measure has been implemented, the employer shall implement a safety monitoring system in conformance with 1926.502(h).	(8) Where no other alternative measure (i.e. scaffolds, ladders, vehicle mounted work platforms, etc.) has been implemented, the employer shall implement a safety monitoring system in conformance with Section 1671.2(b).	NOTE: §1926.502(k) was repealed. In Oregon, 437-003-1501 applies.	
1926.502(k)(9)			
The fall protection plan must include a statement which provides the name or other method of identification for each employee who is designated to work in controlled access zones. No other employees may enter controlled access zones.	(9) The fall protection plan must include a statement which provides the name or other method of identification for each employee (i.e., job title) who is designated to work in controlled access zones. No other employees may enter controlled access zones.	NOTE: §1926.502(k) was repealed. In Oregon, 437-003-1501 applies.	
1926.502(k)(10)			
In the event an employee falls, or some other related, serious incident occurs, (e.g., a near miss) the employer shall investigate the circumstances of the fall or other incident to determine if the fall protection plan needs to be changed (e.g. new practices, procedures, or training) and shall implement those changes to prevent similar types of falls or incidents.	(10) In the event an employee falls, or some other related, serious incident occurs (e.g., a near miss), the employer shall investigate the circumstances of the fall or other incident to determine if the fall protection plan needs to be changed (e.g., new practices, procedures, or training) and shall implement those changes to prevent similar types of falls or incidents.	NOTE: §1926.502(k) was repealed. In Oregon, 437-003-1501 applies.	
The following training provisions supplement and clarify the requirements of 1926.21 regarding the hazards addressed in subpart M of this part.			
1926.503(a)		NOTE: §1926.503 was repealed. In Oregon, 437-003-0503 applies.	
"Training Program."		(1) Training Program.	(4) Training of employees:
1926.503(a)(1)			
The employer shall provide a training program for each employee who might be exposed to fall hazards. The program shall enable each employee to recognize the hazards of falling and shall train each employee in the procedures to be followed in order to minimize these hazards.		✓	(a) The employer shall ensure that employees are trained as required by this section. Training shall be documented and shall be available on the job site.

Federal OSHA 29 CFR 1926 - Fall Protection for Construction	State OSHA Fall Protection Standards		
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1926.503(a)(2)			
The employer shall assure that each employee has been trained, as necessary, by a competent person qualified in the following areas:		✓	✓
1926.503(a)(2)(i)			
The nature of fall hazards in the work area;		✓	✓
1926.503(a)(2)(ii)			
The correct procedures for erecting, maintaining, disassembling, and inspecting the fall protection systems to be used;		✓	✓
1926.503(a)(2)(iii)			
The use and operation of guardrail systems, personal fall arrest systems, safety net systems, warning line systems, safety monitoring systems, controlled access zones, and other protection to be used;		✓	✓
1926.503(a)(2)(iv)			
The role of each employee in the safety monitoring system when this system is used;		✓	✓
..1926.503(a)(2)(v)			
1926.503(a)(2)(v)			
The limitations on the use of mechanical equipment during the performance of roofing work on low-sloped roofs;		✓	✓
1926.503(a)(2)(vi)			
The correct procedures for the handling and storage of equipment and materials and the erection of overhead protection; and		✓	✓
1926.503(a)(2)(vii)			
The role of employees in fall protection plans;		✓	✓
1926.503(a)(2)(viii)			
The standards contained in this subpart.		✓	✓
1926.503(b)			
"Certification of training."		✓	✓
1926.503(b)(1)			
The employer shall verify compliance with paragraph (a) of this section by preparing a written certification record. The written certification record shall contain the name or other identity of the employee trained, the date(s) of the training, and the signature of the person who conducted the training or the signature of the employer. If the employer relies on training conducted by another employer or completed prior to the effective date of this section, the certification record shall indicate the date the employer determined the prior training was adequate rather than the date of actual training.		✓	✓

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1926.503(b)(2)			
The latest training certification shall be maintained.		✓	✓
..1926.503(c)			
1926.503(c)			
"Retraining." When the employer has reason to believe that any affected employee who has already been trained does not have the understanding and skill required by paragraph (a) of this section, the employer shall retrain each such employee. Circumstances where retraining is required include, but are not limited to, situations where:		✓	✓
1926.503(c)(1)			
Changes in the workplace render previous training obsolete; or		✓	✓
1926.503(c)(2)			
Changes in the types of fall protection systems or equipment to be used render previous training obsolete; or		✓	✓
1926.503(c)(3)			
Inadequacies in an affected employee's knowledge or use of fall protection systems or equipment indicate that the employee has not retained the requisite understanding or skill.		✓	✓

2.0 ANSWERS TO FALL PROTECTION CLIFFNOTES

Scaffold/Aerial Lift

- Each platform on all working levels of scaffolds shall be fully planked, with less than a 2-inch gap, or decked between the front uprights and the guardrail supports.
- Supported scaffold poles, legs, posts, frames, and uprights shall bear on base plates, mud sills or other adequate firm foundation.
- Footings shall be level, sound, rigid, and capable of supporting the loaded scaffold without settling or displacement.
- It is never permitted to work outside of the basket while still tied off to an aerial lift.
- Scaffolds shall be erected, moved, dismantled, or altered only under the supervision and direction of a competent person qualified in scaffold erection, moving, dismantling or alteration.
- Each employee on a scaffold more than 6 feet above a lower level shall be protected from falling to that lower level.
- Guardrail systems shall be installed along all open sides and ends of platforms.
- In addition to wearing hardhats each employee on a scaffold shall be provided with additional protection from falling hand tools, debris, and other small objects through the installation of toeboards, screens, or guardrail systems, or through the erection of debris nets, catch platforms, or canopy structures that can contain or deflect the falling objects.
- Frames and panels shall be braced by cross, horizontal, or diagonal braces, or combination thereof, which secure vertical members together laterally. The crossbraces shall be of such length as will automatically square and align vertical members.
- Employees shall always stand firmly on the aerial lift floor and shall not sit or climb on the edge of the basket or use planks, ladders, or other devices for a work position.
- The employer shall have each employee who performs work while on a scaffold trained by a person qualified in the subject matter to recognize the hazards associated with the type of scaffold being used and to understand the procedures to control or minimize those hazards.
- The employer shall have each employee who is involved in erecting, disassembling, moving, operating, repairing, maintaining, or inspecting a scaffold trained by a competent person to recognize any hazards associated with the work in question.

Fall Protection – General

- Each employee on walking/working surfaces shall be protected from falling through holes more than 6 feet above lower levels, by personal fall arrest systems, covers, or guardrail systems erected around such holes.
- Each employee on a walking/working surface shall be protected from tripping in or stepping into or through holes (greater than or equal to 2-inches) by covers.

- Each employee working on, at, above, or near wall openings (including those with chutes attached) where the outside bottom edge of the wall openings are 6 feet or more above lower levels and the inside bottom edge of the wall opening is less than 42 inches above the walking/working surface, shall be protected from falling by the use of a guardrail system, a safety net system, or a personal fall arrest system.

- The employer shall provide a training program for each employee who is exposed to fall hazards.

- All anchorage points must be designed by a Registered Professional Engineer to meet the 5,000 pound requirement with a safety factor of 2.

- Six foot lanyards will not be used unless approved by the Project Sponsor and the District Safety Manager.

- A qualified person must evaluate all anchorage points.

Stairways/Ladders

- A stairway or ladder shall be provided at all personnel points of access where there is a break in elevation of 19 inches or more, and no ramp, runway, sloped embankment, or personnel hoist is provided.

- Stairways having four or more risers or rising more than 30 inches, whichever is less, shall be equipped with at least one handrail, and one stair rail system along each unprotected side or edge.

- When portable ladders are used for access to an upper landing surface, the ladder side rails shall extend at least 3 feet above the upper landing surface to which the ladder is used to gain access.

- Ladders shall be used only for the purpose for which they were designed.

- The top three steps of a stepladder, (Kiewit stepladder policy) shall not be used.

- The employer shall provide a training program for each employee using ladders and stairways, as necessary.

- Every effort should be made to use alternate means of access/egress, e.g. manlift, scaffold.

Fall Prevention and Protection Training

Competent Person Equipment Inspection

Competent Person Equipment Inspection

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Phone 303.922.6246 • Fax 303.922.9960
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INTRODUCTION

This manual is a combination of information from MSA-FP User Instructions, MSA-FP Technical Briefs, and the MSA-FP Competent Person Course text. This material is used in support of classroom training and does not by itself constitute inspection training. The User Instructions, packaged with each product during manufacturing, contain the most current inspection and maintenance information.

INSPECTION

As a routine, the user must inspect the product prior to each use. The user must also be trained and directed to follow the inspection criteria noted in the manufacturer's user instructions. MSA-FP user instructions take the user through the 5-step process for informal inspection listed below:

Step 1	Instructs the user to check the condition of the labels for wear and tear.
Step 2	Tells the user to inspect all fabric materials of the component for condition.
Step 3	Leads the user through the inspection of all metal parts of the component.
Step 4	Is the inspection for all plastic materials found on the component.
Step 5	Instructs the user to check each component and sub-system in accordance with the manufacturer's instructions.

This activity is fundamental to a sound fall protection plan and is a requirement of Occupational Safety and Health Administration (OSHA).

To control product integrity, a **formal inspection** is to be performed following the manufacturer's instructions. The formal inspection must be performed by a person other than the user and at the

interval recommended by the manufacturer. Formal inspection for individual components will be discussed in detail later in this manual.

The MSA-FP Technical Brief on formal inspection explains:

Technical Brief TB9601-*Frequency of Formal Inspection of MSA-FP Fall Protection Equipment*

> The two most widely used ANSI standards for fall protection, A10.14-1991 and Z359.1-1992, both address the captioned subject but differ with respect to the specified time interval between formal inspections. Most products of MSA-FP Manufacturing Company ("Rose") comply with both of these standards. In order to meet or exceed the requirements of both standards, which are applicable to frequency of inspection, it is necessary for MSA-FP to instruct the user and the user's organization to apply the most stringent requirement.
>
> The ANSI Z359.1 standard applies to fall protection equipment used in operations other than construction and sports-related activities and does not apply to window cleaning belts. It requires that users inspect their fall protection equipment before each use. Additionally, the equipment must be formally inspected by a competent person at intervals of no more than one year. If the equipment manufacturer specifies more frequent formal inspections by a competent person than does the standard, the manufacturer's required frequency is to be applied.
>
> The ANSI A10.14 standard applies to fall protection equipment used in construction and demolition operations. It requires that fall protection equipment be inspected not less than twice annually by a competent person and more frequently if required by the manufacturer's instructions and/or the conditions of usage. Additionally, users are required to inspect fall protection equipment before each use. A10.14 recommends (but does not require) that components incorporating rope be inspected by a competent person every three months or more frequently if used under adverse conditions or subjected to very hard wear.
>
> The more stringent formal inspection frequency of A10.14 is based upon the view of the developers of that standard, that equipment exposed to severe usage conditions encountered in construction and demolition operations necessitate this more frequent competent person inspection.
>
> MSA-FP Manufacturing Company provides instructions and markings with its products which state that equipment must be formally inspected by a competent person at intervals of no more than 6 months. When equipment is exposed to severe working conditions, more frequent formal inspection may be required (at the discretion of the user's organization). MSA-FP has established the 6 month formal inspection interval to meet the A10.14 requirement and at the same time, meet the Z359.1 requirement. It is recognized that inspection at 6 month intervals may be more than is necessary for equipment which is not exposed to conditions as severe as those usually encountered in construction and demolition operations. Accordingly,

MSA-FP suggests that the user's organization may consider increasing the maximum formal inspection interval from 6 months to an interval of up to one year, provided the following conditions are met:

1. The equipment is not used in operations covered by the A10.14 standard and/or OSHA final or proposed rules under 29 CFR 1926 (or counterpart rules under state plans), and

2. A written opinion of a competent person is kept on file by the user's organization stating that the equipment is not exposed to conditions which would suggest that formal inspection be performed at intervals of 6 months or less, and

3. The equipment is inspected before each use and is otherwise selected, inspected, rigged, used, stored and maintained strictly in accordance with Z359.1 and MSA-FP's instructions.

It should be noted that not all fall protection equipment in a company's facility would experience the same rate of wear and deterioration. Some equipment may be exposed to operations that are more harsh than others and some equipment may be used with greater regularity. Lastly, equipment that is being used for non-construction operations may be exposed to conditions that are of equal or greater severity to those addressed by A10.14. Accordingly, care should be taken to set up your inspection program to control against oversight of these factors.

In some cases, the environment and work performed will be such that the inspection interval must be shortened. This is an acceptable practice; however, the manufacturer suggests that the interval never be lengthened beyond the recommended intervals.

While the ANSI standards are voluntary, OSHA regulations have the power of law and state the following about inspection of fall protection equipment:

"Inspection considerations." Personal fall arrest systems must be regularly inspected. Any component with any significant defect, such as cuts, tears, abrasions, mold, or undue stretching; alterations or additions which might affect its efficiency; damage due to deterioration; contact with fire, acids, or other corrosives; distorted hooks or faulty hook springs; tongues unfitted to the shoulder of buckles; loose or damaged mountings; non-functioning parts; or wearing or internal deterioration in the ropes must be withdrawn from service immediately and should be tagged or marked as unusable or destroyed.

The theme in both the voluntary and regulatory language is that of a regular and thorough inspection to control the integrity of the product.

Inspection and Maintenance Logs

The results of the formal inspection should be kept in a detailed *Inspection and Maintenance Log.*

The *Inspection and Maintenance Log* is a permanent, written record of all formal inspections and of any maintenance or repair that was performed at any time.

The first entry in the log is the formal inspection that is performed after installation and before the first use of the system. The system is not ready for use until this inspection has been completed. Thereafter, the logs should be used to document semi-annual formal inspections and any major deficiency found during inspection by users.

Inspection logs are an official record that may be required in the event of an incident. The logs should be kept in a secure place that is accessible to users of the system. Logs should be available for inspection upon request by authorized personnel. Users of the system should be authorized to review the logs under controlled conditions, as they must be aware of conditions that may need special attention. It is a good idea to have the manufacturer's instructions stored at the same location so they may be used as a reference when completing and reviewing log entries. Log entries should only be made by designated personnel to ensure that entries are complete, accurate and follow a standard format.

Diligent effort must be made to capture complete information. At a minimum, this includes: the date of inspection; the inspector; the location of the system; part number and description of each deficient component of the system; descriptive information on the nature and location of any deficiency identified; descriptive information on the nature of corrective action taken; the date corrective action was taken; and sign-off by a competent person that the corrective action was inspected and approved.

The logs should use a logical system for identifying location along a rail run. Numbering rail sections consecutively, from lowest to highest, is one good method. Deficiencies can be pinpointed by their location in relation to the lowest rail section (e.g. 36 inches from the top of rail section), which facilitates location of the problem by subsequent climbers or repair personnel. If blueprints were prepared in the system design process, the numbering system can be marked on copies of these drawings to facilitate locating a problem. The numbering system can also be marked at designated points on the rail sections themselves, using indelible ink. Complete and accurate information is thus available for planning the replacement or repair of components.

COMPONENTS

It is important to understand the inspection criteria of each component in a fall protection product. For example, a lanyard is comprised of snaphooks, web strap, adjuster, and label, which is inspected one component at a time. Individual components make up the product that will link with other products to become the personal fall arrest system. Let's study components.

Connectors

Connectors come in many shapes, sizes and forms. A connector is a component or element used to join together parts of a system or components within the system. A connector is also sometimes referred to as hardware. They serve a wide variety of purposes and may be a separate and distinct component, such as a carabiner or an integral part of a component, such as a snaphook spliced to a rope lanyard. The term integral means not removable without mutilating any part of the component or without use of a special tool.

Snaphook

A snaphook is a connector comprised of a hook-shaped body with a normally closed gate or similar arrangement which may be opened to permit the hook to receive an object and, when released, automatically closes to retain the object.

Figure 1

Snaphooks are one of the most frequently used parts of systems for safety at heights. They are integrally spliced or sewn into lanyard and lifeline components. In use, they are frequently connected to and disconnected from parts of other components of the system. Most commonly, they are connected to D-rings of harnesses and anchorage connectors.

Because snaphooks are so widely used, and because they are mechanisms with moving parts that require manual operation, their inspection is always critical.

Carabiner

A carabiner is 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. Different sizes of carabiner are available. As with snaphooks, the size of a carabiner is specified as the width of the gate opening.

Figure 2

A self-locking carabiner usually has a round, spring-loaded sleeve which engages the nose of the carabiner and then rotates automatically to a locked position. This rotation of the gate sleeve is why self-locking carabiners are often called twist-lock carabiners. The tip of the body (called the carabiner nose or simply the nose) interfaces with the gate to keep two objects connected within the carabiner interior.

The trapezoidal-shaped part of the carabiners is referred to as the carabiner body or simply the body. The carabiner is normally an independent component that may be used to connect two other components together. However, carabiners may be a permanent (integral) part of a component by means of attachment through an eye created by inserting a pin across the lower bearing point.

D-Ring

D-rings are always used as integral parts of a component - never as independent components. A D-ring is a connector used integrally in a lanyard, energy absorber, lifeline, anchorage connector, or as an attachment element in a harness. An *attachment element* is a connector that is integral to a harness, usually an O-ring, to provide a means for attachment of other components.

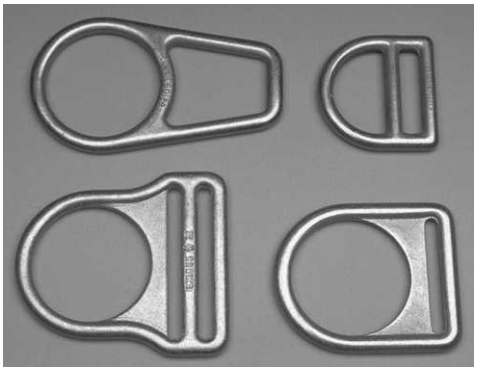


Figure 3

The D-ring consists of a metal ring and a separate slot. The ring provides a means for connecting compatibly matched connectors such as snaphooks or carabiners. The slot provides a means of connecting the D-ring to the component of which it is a part (e.g., the harness). The term "D-ring" is used because it describes the shape of the connector.

There are two main types of D-ring: full-circle and half-circle. A full-circle D-ring provides a circular attachment means when you look at the interior of the ring and it is the most common type. They are commonly integrated into full body harnesses at the hips, back and chest. They are also used to provide a connector that is integral to some anchorage connectors.

A half-circle D-ring has an interior attachment that is a semi-circle. The use of half-circle D-rings is limited and connecting to snaphooks is discouraged because they are often incompatibly matched in relation to some snaphooks with which they are commonly used.

Buckles, Grommets, and Strap Collars

A buckle is a connector that is integral to harnesses and is used to attach strap or webbing segments together or to themselves. Buckles are always used as integral parts of a component, never as an independent component. They must have a corrosion-resistant surface finish that is free of burrs, pits, sharp edges and roughness that would damage materials that interface with them.

The most common uses of a buckle are to attach together two portions of harness straps, such as thigh straps, shoulder straps, chest strap, or shoulder strap retainer. There are two main types of buckle - namely, a tongue buckle and a friction buckle.

Figure 4

A **tongue buckle** (Figure 4) is like the buckle on the belt of your trousers. It consists of a square or rectangular frame with a pin-like tongue. The buckle is joined integrally to a strap of webbing by means of a stitched joint on the side of the frame, which carries the tongue.

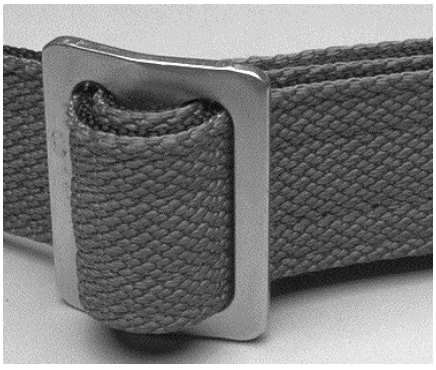


Figure 5

The **friction buckle** (figure 5) connection works on the principle of friction between the buckle and the strap to which it is connected. Friction buckles spread the forces that are applied to them over the entire width of the webbing which they contact. There are several types of friction buckles.

The *single-pass friction buckle* is a friction buckle requiring the webbing to be threaded through the buckle only once in order to fasten it. There are two variations of the single-pass friction buckle: one is the fixed bar single-pass friction buckle that consists of a metal frame with two slots separated by a fixed central bar, and the other is the sliding bar friction buckle that consists of a metal frame with edge slots that capture a sliding bar.

A *double-pass friction buckle* is fastened by passing the webbing back through the buckle a second time. If this is not done, the webbing will slip free of the buckle under load. The double-pass buckle frame appears similar to the single-pass buckle frame. However, the slots in the double-pass frame are larger in proportion to the thickness of webbing passed through them and, accordingly, the buckle does not develop as much frictional resistance to slippage.

Adjusters

An *adjuster* is a connector element used to shorten or lengthen a strap, webbing or rope. Adjusters are always used as an integral element of a component - never as a separate component. They must have a corrosion resistant surface finish that is free of burrs, pits, sharp edges and roughness that would damage materials that interface with them. Adjusters are most commonly used in lanyards.

The type of adjuster used in a component depends on the material from which the component is made. Adjusters designed for use with rope lanyards consist of an *oval ring* to permit the user to shorten or lengthen a lanyard to the desired working length. Strap lanyards employ a *rectangular adjuster* similar in shape to a fixed-bar, single-pass friction buckle, but which is sized to fit the lanyard.

Adjusters are also used in harnesses to adjust the length of various straps. Most commonly used are *friction buckles* to permit adjustment of shoulder straps and chest straps. The shoulder strap adjuster is usually a single-pass friction buckle. Depending on the manufacturer and harness model, the chest strap is either a single or double-pass friction buckle.

Miscellaneous Connectors

There are numerous other connectors that may be integrated into components or systems. The most common of the miscellaneous hardware items is the *O-ring*.

An ***O-ring*** (figure 6) is a circular metal ring that provides a connection to snaphooks or carabiners and is typically used as integral parts of a component, rarely as an independent component. As with other metal components, O-rings must have a corrosion resistant surface finish that is free of burrs, pits, sharp edges and roughness that would damage materials that interface with them.

Figure 6

A ***utility snap*** (figure 7) is a small, lightweight snaphook with no locking mechanism used to connect components that will not experience any significant load forces. One common use is on a detachable back pad that clips into the hip D-rings of a harness to

Figure 7

provide lower back support during work positioning. The utility snap is never used to connect fall arrest components of a system.

Inspection, Maintenance, and Storage of Connectors

Hardware (connectors) are inspected and tested by the manufacturer before they leave the factory. Despite this, diligent field inspection is necessary because damage to hardware during transit or use is often not readily visible. Take great care inspecting all connectors and, if any question about the condition exists, remove the product from use. Any equipment which is removed from service must be tagged to identity it as not to be used and turned over to a designated Competent Person (per Federal OSHA) for more thorough inspection and disposition.

Maintenance and storage of connectors which are integral to components is described in the lessons dealing with those components. Maintenance and storage of connectors which are independent components, such as carabiners, is described later in this lesson.

General Inspection Rules

There are several general rules that must be followed regarding the inspection, maintenance, and storage of connectors as well as the other equipment components and systems used for safety at heights.

1. Comply with all manufacturer instructions. Such instructions should be accessible by the user.

2. Equipment shall be inspected by the user before each use and additionally by someone other than the user, usually a designated Competent Person (per Federal OSHA). Inspection intervals should not exceed one year for general industry or six months for the construction industry as recommended by ANSI standards.

3. Inspection criteria (pass or fail) shall equal or exceed the criteria established by industry standard, governmental regulation, or the manufacturer's instructions.

4. In addition to the inspection requirements set forth in the manufacturer's instructions, the equipment shall be inspected at both inspection levels for:

    - Absence or illegibility of markings
    - Absence of any elements affecting the equipment form, fit or function
    - Evidence of defects in or damage to hardware
    - Evidence of defects in or damage to straps or ropes
    - Altered, damaged, or improper function of mechanical devices and connectors

5. When inspection reveals defects, damage, or inadequate maintenance of equipment, the equipment shall be removed from service or undergo adequate corrective maintenance before return to service.

6. Maintenance and storage of equipment shall be conducted in accordance with the manufacturer's instructions. Unique issues, which may arise due to conditions of use shall be addressed with the manufacturer. The manufacturer's instructions shall be retained for reference.

7. Equipment which is defective or which is in need of scheduled maintenance shall be tagged as "unusable", removed from service and delivered to the Competent Person.

8. Scheduled maintenance of equipment and disposition of equipment tagged as "unusable" shall be performed by a designated Competent Person.

9. Equipment should be stored in a manner that will preclude damage from environmental factors such as heat, sunlight, excessive moisture, oil, chemicals and their vapors or other degrading elements.

General Inspection of Connectors

Inspect each piece of hardware for the following conditions. If there is any evidence that one or more of these conditions exist, immediately remove the item from use; tag it as "unusable" and deliver it to a designated Competent Person.

Cracks

A crack in hardware is serious damage which requires immediate discontinuance of use and removal of the product. Cracks result from a flaw in the structure of the underlying metal. They can develop over time or can appear suddenly if the component is struck sharply or is exposed to high heat.

Heat Damage

Exposure to high temperature is evidenced by discoloration of the plating and/or distortion of the metal of a connector. Exposure to high heat causes the metal to lose some of its critically-important properties such as strength.

Distortion

Distortion can result from improper use such as side loading of a snaphook gate, exposure to high heat, or from excessive loading. It is also a serious form of damage that requires that the component be immediately removed from use. Check the entire surface of hardware elements for distortions.

Corrosion and Fitting

Corrosion is evidenced by buildup of crusty, sometimes flaky scale or rust on the surface of a piece of hardware. Fitting is evidenced by small holes, usually clustered, which have penetrated into the

metal. Either of these conditions is evidence of a serious exposure to chemicals or corrosives, and indicates that the strength of the element has been impaired.

Excessive Wear

Excessive wear exists if the plating has been worn through or the thickness dimensions of a piece of hardware have been visibly reduced. Again, this is evidence that the strength of the element has been reduced. Remember that some kinds of plating will change color gradually; this is a normal condition. Care must be taken to distinguish between normal wear such as a lightening of the plating, and excessive wear that may have reduced strength.

Sharp Edges

All hardware elements are tumbled before plating in order to remove sharp edges that might cause damage to other elements. Sharp edges can result from misuse, improper plating or abnormal wear. All pieces of hardware should have a sufficient radius at the edges to prevent a sharp edge from causing damage.

SPECIFIC EQUIPMENT INSPECTION

Inspecting and Maintaining Snaphooks

Press on the gate face to make sure it will not open under pressure before it is unlocked. Open and release the gate several times. The gate should seat firmly into the nose without binding and should not be distorted or obstructed. There should not be more than 1/8" of play between the gate and nose of the hook body. The spring(s) should exert sufficient force to return the lock and gate to their original positions. Examine the snaphook for any sign of alteration such as a locking mechanism that has been tampered with or removed.

Snaphooks will not usually require any user maintenance, other than removing foreign matter such as grease. In no case should you attempt to dismantle a snaphook to clean it.

Inspecting Carabiners

Press on the carabiner gate face to make sure that it remains closed. Manipulate the locking mechanism to open and release the gate. The gate must close firmly and lock (twist) with no evidence of binding or obstruction. The twist-lock must return to the fully locked position.

If necessary, lubricate the twist-lock mechanism and gate pin (hinge) with a silicone based lubricant. This is the only maintenance you are permitted to perform.

Carabiners should be stored together with the other components with which they are used. Since they are easily misplaced, they may be stored attached to a mating connector such as a D-ring.

Inspecting Buckles

Check the operation of buckles by fastening and unfastening the straps. Tongue buckles should have a roller around the frame end. Grommets should be securely fastened on both the top and underside of the webbing, with no sign of coming free or distortion. The tongue should not be bent, and should rest evenly against the frame.

Fasten a friction buckle and pull to make sure that the webbing will not creep. If equipped with a sliding bar, make sure the bar moves as it should. The spring used with some sliding bar buckles should maintain pressure on the webbing captured by the buckle.

Inspecting a Full Body Harness

As with any component of a fall arrest system, the two-stage inspection process must be followed. A full body harness must be inspected before and after each use and by a designated competent person at least every six months

Pay particular attention to harness labeling during inspection. Each harness should have labels which convey all of the following information:

- Part number, model and manufacturer;
- Year of manufacture;
- Material of construction;
- Size of the harness;
- The correct fall arrest attachment element;
- The purpose(s) of any other attachment elements;
- Maximum weight of user (capacity), including clothing and equipment;
- Donning, adjusting and use information;
- Maximum free fall distance permitted.

If any of this information is missing, the harness should be removed from use, tagged as "unusable", and delivered to the person designated by your organization.

Harnesses (figure 8) will usually be stitched using a special pattern of lock-stitches. The stitching will be in a color that contrasts with the webbing to assist in the inspection. If any stitches are pulled or broken, the harness must be removed from service following the above-described procedure.

The webbing should be inspected for cuts, tears, stretching of fibers, fraying, raveling of edges, excessive wear or abrasion, chemical attack, excessive soiling, burns, weld spatter and alteration. When inspecting the webbing, hold your hands six to eight inches apart, and flex the webbing into a "U" shape to reveal frayed or broken fibers. The presence of hardened or discolored spots on the webbing is an indication of exposure to chemical attack or an excessive heat source.

If a harness does not pass inspection for any reason, it must be removed from use, marked as unusable, and promptly delivered to the designated person. Defective harnesses should be stored separately from usable harnesses, or they should be destroyed by cutting the webbing into short, unusable lengths.

Harnesses may be cleaned in warm water and mild laundry detergents suitable for cleaning household clothing. Only non-abrasive cleaners should be used. Excess soiling can be removed using a damp sponge with a vigorous rubbing motion. Excess soap should be removed using a clean cloth. Harnesses should be hung in a clean, dry place to dry. Do not hang or store harnesses in sunlight or close to heat sources.

Care, Maintenance, Storage, and Inspection of a Pullover Harness

Cleaning Instructions: Clean the Pullover harness with a solution of water and mild laundry detergent. Dry hardware with a clean cloth and hang harness to air dry. Do not speed dry with heat. Excessive accumulation of dirt, paint, or other foreign matter may prevent proper function of the Pullover harness and, in severe cases, weaken the webbing. Questions concerning harness conditions and cleaning should be directed to MSA-FP Manufacturing Company.

Maintenance and Service: Equipment which is damaged or in need of maintenance must be tagged as "UNUSABLE" and removed from service. Corrective maintenance (other than cleaning) and repair, such as replacement of elements, must be performed by the MSA-FP factory. Do not attempt field repairs.

Storage: Store the harness in a cool, dry and clean place out of direct sunlight. Avoid areas where heat, moisture, light, oil, and chemicals or their vapors or other degrading elements may be present. Equipment which is damaged or in need of maintenance should not be stored in the same area as usable equipment. Heavily soiled, wet, or otherwise contaminated equipment should be properly maintained (e.g. dried and cleaned) prior to storage. Prior to using equipment which has been stored for long periods of time, a Formal Inspection should be performed by a competent person.

Inspecting Lanyards

As with other components for safety at heights, inspection is a two-stage process. This means that inspection is performed: (1) by the user before each use, and (2) by a competent person, in a formal inspection, at least once a year.

Lanyards should be equipped with inspection tags provided by the manufacturer. The inspection tag indicates the month and year of the formal inspection, and is punched by the inspector once it has passed that inspection. If the most recent formal inspection is not within the last year, you should remove the lanyard from use until it has passed inspection by a competent person.

Lanyard labels must also provide instructions and cautions regarding use and inspection, and must identify the manufacturer, product part number and the date of manufacture. The date of manufacture provides an indication when a lanyard should be removed from service. All lanyards grow weaker with age and use. Generally, a lanyard is removed from use after 3 years or earlier if inspection reveals a weakened condition. If at any time you are uncertain about whether a condition you notice is sufficient cause to remove a lanyard from use, consult your supervisor, a qualified

person or the manufacturer. Once removed from service, the lanyard is to be clearly marked as unusable and then destroyed.

How to Inspect Lanyards

When you inspect a lanyard, begin at one end and work your way to the other end. If the lanyard is equipped with a connector, first inspect the connector and make sure it is functioning correctly. If the lanyard has a seized (whipped) end, the end should be seared so the fibers are fused together and taped to prevent raveling.

Next, inspect the method used to join the connector to the lanyard. A thimble, whether used to join a snaphook to a lanyard or as an attachment element in itself, should be completely captured by the rope or wire rope loop around it. The rope should be seated within the groove of the thimble. The free end of the rope should be spliced into the rope using a complete four tuck splice (rope lanyards) or swaged fittings (wire rope lanyards). The strand ends of rope lanyards should be gathered together with tape or a hog ring. The thimble itself should not be deformed or damaged. Sewn loops on strap lanyards should have no broken, frayed or worn stitching.

Proceed to inspect the length of the lanyard, working your way from end to end. Rotate rope and wire rope lanyards as you inspect them so you observe the entire surface area. Inspect both sides of strap lanyards. Flex the lanyards as you inspect them to reveal damage that is not readily apparent

Inspect for any of the conditions described below and if they are found, remove the lanyard from use.

- Cut or frayed strands
- Excessively abraded strands or fibers
- Alterations made by a person
- Broken stitching (strap lanyards)
- Exposure to chemicals, heat and flame
- Missing or illegible labels

Table 1, summarizes the effects of exposure to chemical, heat and open flame on various materials.

Table 1. Indications of Exposure of Lanyards to Heat, Chemical and Flame

Type of exposure	Material of Construction		
	Twisted Rope	**Webbing**	**Wire rope**
High heat	Nylon and polyester will be brittle, with a shriveled, brownish appearance. Fibers will break when flexed.	Same as rope.	Resists heat well. Vinyl cover may be melted. Underlying metal fibers may be exposed.
Chemicals	Color will change to brown. Fibers will be brittle and crack when flexed. If exposed to solvents or paints, movement of fibers will be restricted.	Same as rope. Webbing may show transverse cracks when flexed.	Resists chemical exposure well
Open flame sources or molten metal	Rope and webbing strands fused together. Hard, shiny areas evident. Will feel brittle and may crack when flexed. Nylon turns brown. Polyester looks clear.	Same as rope. Weld spatter will show up as small, irregularly spaced burnt areas.	Resists exposure to flame well. Vinyl cover may be damaged.
Aging	Nylon will appear faded and yellowish. Rope becomes less flexible.	Webbing will become stiff and harder to flex. Will retain flexed shape somewhat when released.	No visible signs of weakening due to aging.
Note: When inspecting wire rope lanyards, follow those instructions also to identify conditions such as broken wires, birdcaged, crushed, kinked and bent wire rope.			

Maintenance of Lanyards

Maintenance of lanyards involves cleaning and storing them according to the following guidelines. Dust, dirt and foreign matter should be removed by wiping them away with a damp sponge. The surface of the rope or webbing can then be scrubbed using warm water and a mild soap solution. Once cleaned, lanyards should be wiped dry with a clean cloth and hung to dry indoors, away from direct exposure to sunlight or high heat. You should never use strong solvents or harsh, abrasive cleaners to remove such contaminants as grease from a lanyard. They will cause permanent damage to the material.

Before using any products, you must always read and follow the manufacturer's instructions and labels included with those products, including the ones described here.

Inspecting Energy Absorbers

As with any component of a fall arrest system, pre-use inspection by the user and inspection by a competent person at least once a year are required.

The connectors and other elements connected to the energy absorber should be inspected according to the instructions presented elsewhere in this course.

Inspect all areas on the cover of the energy absorber. The cover should not be torn or damaged. A slight tear at one end of the cover is an indication that a mild fall may have occurred. If such a tear is found, immediately remove the component from use and turn it in to your supervisor.

The connecting loops should be inspected to make sure there is no damage or alteration. All stitching must be intact. The thread is of a contrasting color to facilitate this inspection. The webbing should be free of cuts, tears, abrasions, undue stretching or excessive wear. The wear pads which cover the webbing loops should be present and in good condition.

The energy absorber should be cleaned with a damp sponge, wiped dry with a clean cloth and hung in a clean, dry place indoors to dry. No harsh abrasives or solvents should ever be used, nor should the energy absorber ever be immersed in water. While the cover is water resistant, it will not repel water if submerged. Once the internal webbing is soaked, it will not dry out completely inside the protective cover. Water damage can result in a substantial reduction in strength. If the energy absorber is so dirty as to require this type of cleaning, it should be removed from use and destroyed.

INSPECTING COMPONENTS OF PERSONNEL-RIDING SYSTEMS

A competent person, other than the user, must inspect each component of the personnel-riding hoist system before each use, and at regular intervals.

Inspecting the Tripod

To inspect the tripod, check for cracks, bends and deep nicks in the surface of each leg and the head assembly. Make sure that all parts are attached and in good condition. The lower leg should slide freely inside the upper leg. Each leg should lock into position when swung out. Additional instructions are contained in the User Manual shipped with the tripod.

Inspecting the Davit

Check the entire surface of the davit for cracks, bends and deep nicks in the surface of the tube. Check that the anchorage rings are undamaged. Check the anchoring receptacles for any sign of weakening of the anchorage. Check that the davit rotates freely in its anchoring elements. Additional inspection instructions are provided in the User Manual shipped with the davit.

Inspecting and Maintaining the Hoist

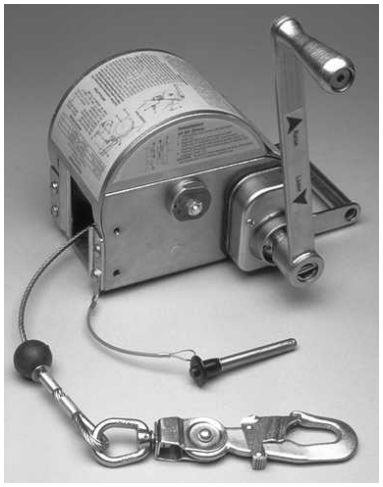


Figure 9

The hoist (figure 9) must be inspected before each use. In addition, it must be inspected by a competent person other than the user at intervals of no more than six months. The manufacturer specifies a six month inspection interval for the hoist because it is usually subject to frequent use. Bi-annual factory service is also required. Inspection and factory service date labels are affixed to the hoist housing. Check that the most recent formal inspection shown is within the previous six months, and that the most recent factory service was within the previous year.

To inspect the function of the hoist, mount it to a suitable anchorage connector. Maintaining tension on the hoist line (with a gloved hand), rotate the handle counterclockwise to pay line out. Then rotate the handle clockwise to check for proper line retrieval. A clicking sound indicates that line retrieval is functioning correctly. Remove the product from use and return it to your supervisor

if no clicking sound is heard. Pull on the hoist line to make sure the braking system functions. No more than one foot of line should be extracted when you perform this check.

Examine the handle, drive shaft and housing for cracks, bends, dents and nicks which might impair function. Check for corrosion and broken welds, and remove the device from use if these conditions are found. Make sure that all labels are present and legible.

Using fingers, check that all bolts and nuts on the housing and installation bracket are tight. If necessary, tighten them.

Check that the impact load indicator pin on the drum axle nut is not protruding from the nut. This pin indicates whether the hoist has experienced a dynamic load sufficient to activate the internal energy absorption mechanism. If the pin is protruding, remove the hoist from use.

Check the optional emergency drive (if provided). The emergency drive pin should be present. If it is not, the emergency drive has been activated and the hoist should be removed from use.

If using the boom mount hoist, inspect the extension frame and anchorage hook for cracks, bends, dents, and nicks which might impair strength. Make sure the pulley at the tip of the extension frame rotates freely and is not excessively worn.

Inspect and maintain the hoist line and swivel snaphook carefully, according to the detailed instructions form the manufacturer.

Maintenance of the hoist is limited to cleaning of the housing using a damp sponge. Never immerse the hoist in water to clean or rinse it.

The hoist should be stored in a clean, dry place indoors. If stored for an extended length of time, the hoist should be inspected periodically. During storage, never let the hoist rest on concrete surfaces as ingredients in the concrete can corrode the hoist. Before use after extended storage, it should be inspected by a competent person.

Inspecting the Fall Arrester and Lifeline

Figure 10

To inspect the fall arrester (figure 10), carefully examine both sides of the housing. Make sure that all labels are present and legible. Make sure that the housing is free of dents, cracks, deformations and corrosion that could affect its performance. Make sure that the sheave and the two rollers rotate freely. The cam should not move freely. If you push it firmly, it should snap over to the roller in the direction you push. Check that the cam will move in this manner toward each of the two rollers.

After installing the fall arrester on the lifeline and before using the system, test the fall arrester's function. Grasp the carabiner connected to the cam and slide the fall arrester down and up. It should ride easily along the lifeline without catching. Pull sharply down with a follow-through motion to

lock the fall arrester on the lifeline. The fall arrester's downward motion should be quickly arrested, with the rope seated into the sheave and the cam pinched against the rope and roller to the lower side of the fall arrester. To reset the fall arrester after this check, push the cam to a central position again and slide the fall arrester up and down until it rides along the lifeline again.

To inspect the lifeline, examine short incremental sections of line while rotating the line to make sure you inspect it thoroughly. Inspect for cut, frayed, burnt, melted and worn or abraded fibers. Also inspect it for signs of exposure to chemical attack or aging. Chemical attack will be evidenced by brittle fibers or localized areas of stiff, bonded fibers. Extreme fading and general stiffness are signs of weakness due to aging.

Pay particular attention to the area around the formed eye at the top of the life-line. Inspect the lifeline for signs of abrasion or cutting around the metal thimble. The thimble at the formed eye should be securely captured and should not flex at all where it adjoins the ferrule. The two labels at the other end of the swaged ferrule should be legible and intact.

INSPECTING AND MAINTAINING SELF-RETRACTING LIFELINES

INSPECTING AND MAINTAINING SELF-RETRACTING LANYARDS (SRLS)

Figure 11

Inspection of an Self-Retracting Lanyard (SRL) (figure 11) must be done before each use and at intervals of no more than six months by a competent person other than the user. Note that the interval between formal inspections by a competent person is reduced to six months maximum, whereas it is once a year for some other components. The reason for this is that it is extremely difficult to perform adequate pre-use inspection on an SRL that is installed permanently at a height. For example, damage can occur to sections of the line which cannot be seen by a user at any normal work elevation. Given this possibility, many manufacturers specify that inspection by a competent person be performed more frequently than once a year.

An SRL must be inspected by a competent person other than the user at least every six months.

During pre-use inspection, check as many of the inspection items listed below as possible. The semi-annual inspection should be logged and must include all items below.

Inspecting the Function of an SRL

Before each use, check the function of the SRL. First, check lifeline extraction and retraction using the tag line.

Grasp the snaphook at the end of the line firmly in both hands and pull sharply downward with a follow-through motion. The device should lock and remain locked until you release the line tension. Release tension and check that line extraction and retraction still function correctly. Perform this locking test three (3) times. If the device does not lock properly each time, notify your supervisor.

Inspection of Housing and Installation Bracket

- Check that all labels are present and legible.
- Using your fingers, check that all bolts and nuts securing the housings are present and tight.
- Check that no parts are missing or have been altered or substituted.
- Check that the housings and installation bracket are not excessively dented, cracked, deformed, ruptured, corroded or pitted. Minor dents that do not impair normal function do not require action. However, any condition which appears to impair function is cause for removing the device from service.

Inspection of Line

When inspecting the line, inspect the snaphook and snaphook/line attachment element according to the instructions.

Wear gloves when inspecting wire rope to prevent cuts and slivers when running hands over the wire rope. While inspecting the line, keep it from contact with heavily soiled surfaces and coil it loosely to prevent kinking. Check carefully for each of the conditions described below. Refer to the illustrations to get the basic terminology concerning wire rope inspection.

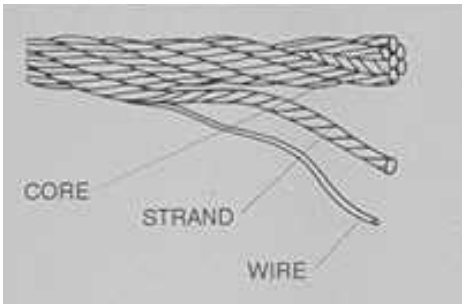


Figure 12

The line is constructed from 7x19 wire rope. This means that there are 7 strands, each composed of 19 wires, laid over the steel core of the wire rope, as shown in Figure 12. The lay length is the distance it takes one strand to travel completely around the wire rope. Lay length measurement is shown in figure 13. (Note: Some SRL components have 19x7 wire rope.)

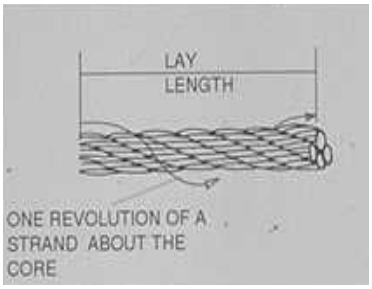


Figure 13

Broken Wires

Flex the wire as you inspect it to reveal hidden breaks in the wires. Broken wires should be bent back and forth in the direction of the lay to break them off inside the strand of which they are a part, as shown in figure 14.

Do not tug on broken wires. This will leave jagged ends and can cause internal damage.

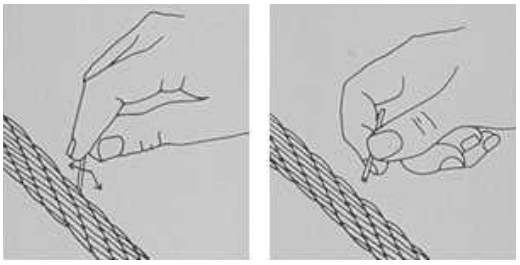


Figure 14

Log the location of broken wires in the instruction manual for the device you are inspecting. Refer to the log for the location of broken wires, which were previously detected. The device must be removed from use:

- If there are six or more broken wires in one lay, or three or more broken wires in one strand within one lay;
- If there are any broken wires within one (1) inch of the thimble or swage fittings at the termination of the line.

Worn or Abraded Wires

Wear and abrasion are caused by friction, and are usually indicated by brighter areas along the wire rope length.

Remove the device from use if any surface wires in one area are worn by more than a third of their diameter.

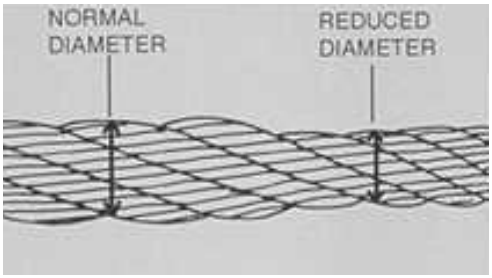


Figure 15

Changes in diameter (figure 15) include both bulges and reductions in diameter of the wire rope. This is an indication of serious internal damage. Remove the product from use if diameter varies by more than 0.05 inches (1.3mm) in one area.

Check for crushed or flattened strands and remove the device from use if these are found.

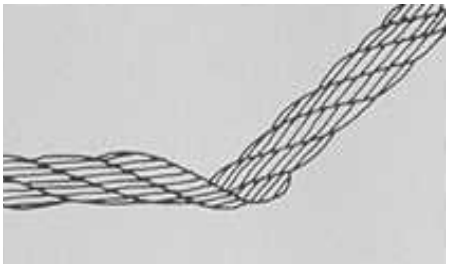


Figure 16

Kinks (figure 16) are formed by permitting slack to build up in the wire rope. Bends are evidence of kinks previously formed, and can also be formed by drawing wire rope over sharp edges. Kinks and bends are both serious forms of damage which require that the device be removed from use.

Corrosion

Corrosion is a particularly serious form of damage that is characterized by discoloration of wires. It can occur from exposure to harsh environments or failure to keep a wire rope adequately lubricated. Corrosion will usually develop inside the wire rope before evidence is seen on surface wires. If you see evidence of corrosion or rust on surface wires, remove the device from use.

Heat Damage

Check for heat damage, torch burns and electric arc strikes. Remove the device from use if any of these conditions are found.

Birdcaging and Unlaying of Wire Rope

Birdcaging (Figure 17) and unlaying of wire rope are indicated by gaps, loops or clearance between strands and among wires in a strand. Remove the device from use if these are found.

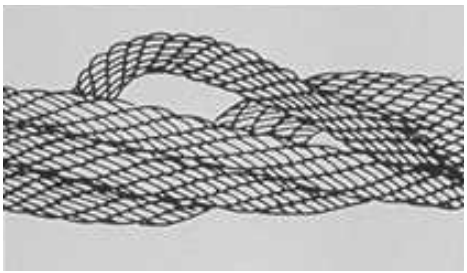


Figure 17

INSPECTING AND MAINTAINING FIXED PERMANENT CLIMBING SYSTEMS

As with any piece of safety equipment, the two-stage inspection process is adhered to. Formal inspection is performed at regular intervals by a competent person. Informal inspection is normally performed before each use. Since it is not possible to complete informal inspection of a climbing system before use, informal inspection is performed during use.

A *deficiency* is a generic term used to describe a condition that is abnormal. A deficient

component is not in good working order and must be maintained or repaired to return it to that condition.

REMEMBER

Remember that you are ultimately responsible for your safety aloft, so you should never rely on someone else to inspect the equipment on which you are depending. You can never inspect too often or too carefully.

When you inspect a fixed permanent climbing system, you are looking for three types of *deficiency:*

- *Damage*. Damage is a general term used to describe deficiencies that occur during the normal course of work. Damage includes such things as *dents* (depressions in the metal), *nicks* (gashes in the metal), *cracks* (fissures in the metal), *excessive wear* (wear which may affect strength or function), *broken welds*, *corrosion* and *missing pieces*. Damage is usually caused through improper transport, handling and use of equipment.

- *Defect.* A defect is a basic deficiency in the composition of a component that usually results from an improperly performed manufacturing process. Defects are rarely found, because equipment design is qualified before production and inspection is performed throughout the manufacturing process.

- *Alteration.* Alteration is the deliberate modification of a piece of equipment by a user. No field alterations by users are permissible, even if they appear to improve the performance of a component.

REMEMBER

NO FIELD ALTERATIONS OF EQUIPMENT ARE PERMISSIBLE.

Informal And Formal Inspection Procedures

Inspect the fall arrester before you install it on the safety rail. Make sure that all labels are present and legible. Test each moving part to see that it moves correctly and freely. Make sure that no part is excessively worn, is missing, or has been altered. Then install the fall arrester on the safety rail. Test the fall arrester locking action at least three (3) times on the bottom section of safety rail. It should lock each time. After each test, the fall arrester (figure 18) should glide easily up the rail as you reposition it to begin the subsequent test.

Figure 18

As you climb, check each component of the fixed permanent climbing system. Make sure it is undamaged, has not been altered, and that it complies with its *performance specification*.

The *performance specification* is a description of the function of a component - how it is meant to operate under normal conditions.

Note that trained installation personnel are permitted to perform some types of minor *field fitting* during installation, such as cutting custom length rail sections. Installation records will show the locations of field fit components. You will need to distinguish between this permissible alteration and unauthorized alteration performed after installation.

Check the rail sections (figure 19) for smooth travel of the fall arrester. If foreign matter is present on the rail, remove it. Check for corrosion along each rail section. Check that each rail section is facing in the correct direction. Make sure that each rail section is correctly aligned and abutted with the adjacent section so that the fall arrester travels smoothly past these joints.

Figure 19

Check each rail connector and mounting assembly for missing, loose, damaged or altered parts. Be sure to check the anchoring structure for damage at locations where mounting assemblies are attached.

Check all accessory components, such as footrests, pivot davits, turntables and bypass assemblies to make sure they function correctly. Check for missing, loose, damaged or altered parts.

Formal inspection is a planned process that must be performed at least every six months by a competent person, according to the inspection procedure detailed above. Your safety management will determine how frequently the periodic inspection must be performed. The frequency of formal inspection depends on numerous factors, including the nature and severity of workplace conditions and the types of activities for which the equipment is used. Equipment that is used on a regular basis, in harsh environmental conditions, will normally require inspection more frequently than equipment which is used infrequently and in a mild environment.

Before beginning a formal inspection, you should review the inspection and maintenance logs (see below) to familiarize yourself with all maintenance activities performed since the previous inspection. Inspect these areas closely because they were previously identified as deficient. Examine the logs carefully to identify areas which seem to have recurring problems. If the same or similar problems are frequent at a location, steps should be taken to identify and eliminate the root cause of the deficiency.

When you perform a formal inspection, do not rely on the climbing system you are inspecting for fall arrest - use a portable temporary climbing system.

Pay particular attention to inspecting for types of deficiency which develop slowly such as corrosion or loosening of nuts. This type of problem damage is very easily overlooked by frequent users of the system because they see no obvious change from day to day. Additionally, always remember that frequent climbers may become lax in inspection over time, and are likely to omit certain key inspection points. They may not continually inspect areas of the system that are difficult to access.

REMEMBER

Use a portable temporary climbing system when formally inspecting a fixed permanent climbing system. Do not rely on the system you are inspecting.

Fixed permanent climbing systems are fairly durable. Any serious deficiency is therefore cause for serious concern. If any deficiency is noticed during the formal inspection, immediate steps should be taken to identify the cause of the deficiency. This is best done by examining the area around the damaged component while aloft. Take all appropriate steps to ensure that the same conditions giving rise to the deficiency do not recur.

Once your inspection is complete, you must complete the inspection and maintenance logs. Carefully fill out the logs to provide a complete description of any deficient condition.

Do not permit the system to be used until all required maintenance has been performed and you have reinspected the system and determined that it is suitable for use. If you have any question as to the strength or function of the system or any component, consult a qualified safety engineer or the manufacturer.

If you identify any deficient condition during inspection, you must also attempt to determine why the damage was not noticed during informal inspection by users of the climbing system. It is unlikely

that a deficient condition will develop between the last use of the system and the formal inspection. This implies that the deficiency was not noticed, ignored, or considered a normal condition by users of the system. Retraining of the users must be accomplished to verify they understand how to perform their inspection duties.

APPENDIX A

MSA-FP User Instructions – Care, Maintenance, Storage, and Inspection Sections

Pullover Harness

Vest Type Harness

Lanyard – with Integral Dyna Brake Shock Absorber

Lanyard – rope, strap, wire rope

Anchorage Connector Strap

Self-Retracting Lanyard – Strap type

Self-Retracting Lanyard – Wire rope type

Automatic Retractable Descender – Dynescape

Hoist – Dyna-Hoist Side/Boom mount

Fall-Rescue Work System – Ropod

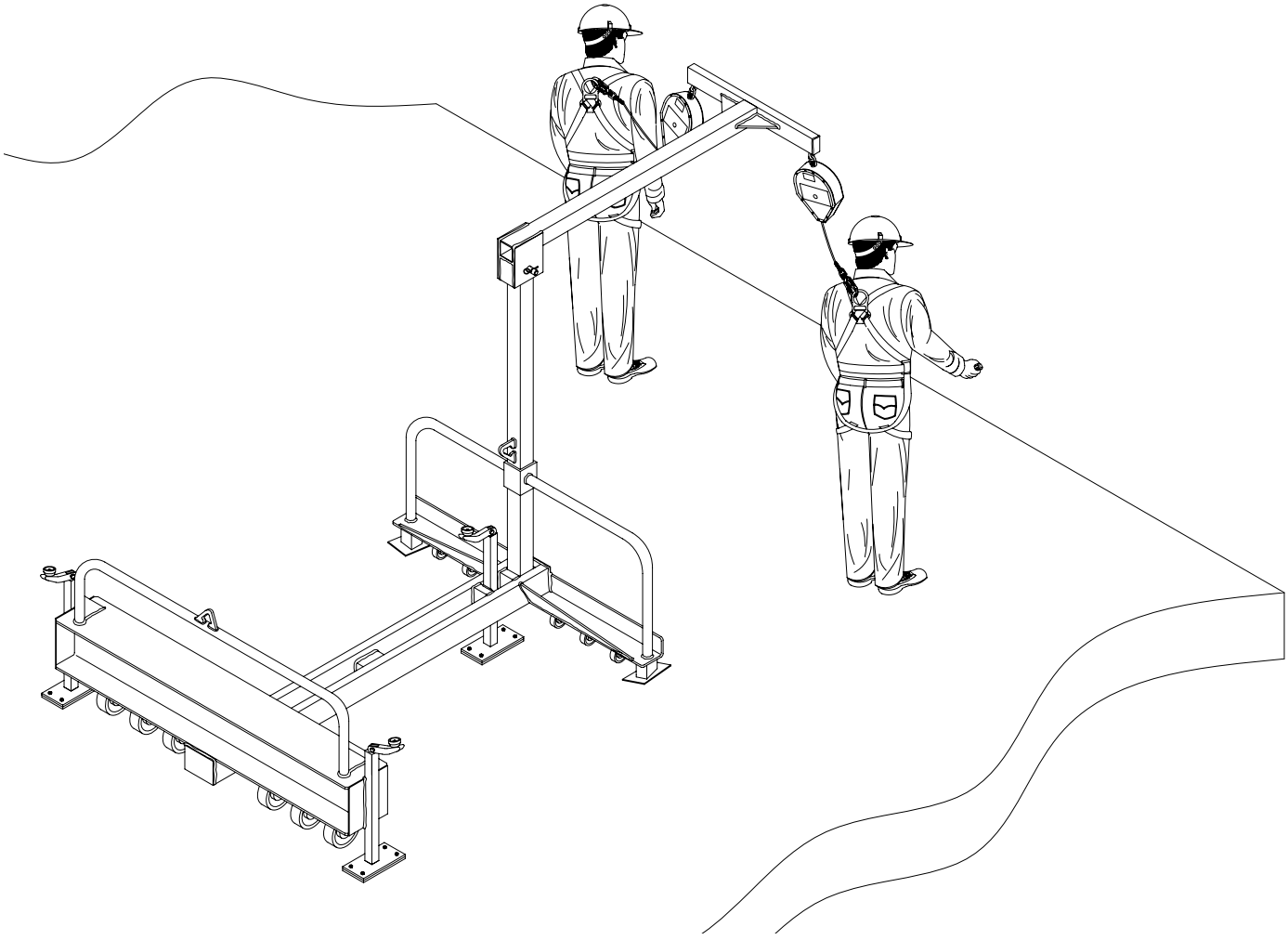
INDEX

OPERATION & MAINTENANCE MANUAL FOR THE

MILLER® EDGE™ FALL PROTECTION SYSTEM

The Miller® Edge™ and related equipment is designed to provide portable fall protection for workers subjected to fall hazards during leading edge construction.

WARNING: ALL PERSONS USING THIS EQUIPMENT MUST READ, UNDERSTAND AND FOLLOW ALL INSTRUCTIONS. FAILURE TO DO SO MAY RESULT IN SERIOUS INJURY OR DEATH. PREGNANT WOMEN AND MINORS MUST NOT USE THIS PRODUCT.



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I. GENERAL REQUIREMENTS

A. WARNINGS AND LIMITATIONS

Proper precautions should always be taken to remove any obstructions, debris and other material from the work area that could cause injuries or interfere with the operation of the system. Also, caution should be taken to ensure all equipment will be clear of all other recognized hazards and proper ventilation has been provided in the work area before work begins.

Note: Users should be familiar with pertinent regulations governing this equipment. All individuals who use this product must be correctly instructed on how to use the system and must read and understand the following instructions before using the system.

- **Only trained personnel should use this system and its components.**
- **Do not use if the unit or any part of the system appears to be damaged.**
- **Do not use the system if any components do not operate properly.**
- **Use in highly corrosive or caustic environments dictates a more frequent inspection and servicing program to ensure the integrity of the system is maintained.**
- **Do not attempt to repair this system.**
- **Personal fall arrest systems and components subjected to impact loading shall be immediately removed from service and shall not be used again for employee protection until inspected and determined by a competent person to be undamaged and suitable for reuse.**
- **Employer must provide for prompt rescue in the event of a fall.**
- **All equipment must be inspected before each use.**
- **Any component exhibiting deformities, unusual wear, or deterioration must be immediately discarded.**
- **This product is designed for personal fall protection. Never use fall protection equipment for purposes other than which it is designed.**
- **Never use fall protection equipment for towing or hoisting.**
- **Always check for obstructions below the work area to make certain the potential fall path is clear.**
- **Use only compatible locking snap hooks or locking carabiners with this product.**
- **Use only approved Miller hardware with this product.**
- **Do not attempt to move the unit while workers are attached.**
- **Do not use unit on uneven or sloped surfaces greater than 5% from the horizontal.**

B. LIMITATIONS

The Miller® Edge™ is intended for use on horizontal surfaces or surfaces with ≤ 5% grade. The following limitations must be read, understood and followed before installation can take place.

- **FLOOR STRUCTURE:** The structure to which the unit is used must be no less than 5/8" (15.9mm) thick plywood and capable of supporting the weight of the system and the loads applied by the system in event of a fall. The surface must be even and no greater than a 5% grade from horizontal.

- **SYSTEM CAPACITY:** The maximum number of user's per unit is 2 (two). Only (1) user per individual anchor point is permitted. The capacities are based on maximum user's weight, including tools, clothing etc. of 310 lbs. (140.6 kg) each or 620 lbs. (281.2 kg) total weight. ***Warning: Maximum capacity for each attachment point is 310 lbs. (140.6 kg). Do not exceed this weight per individual attachment point.***

- **COMPONENT COMPATIBILITY:** The Miller® Edge™ is designed for use with Miller retractables and approved components only. Substitution or replacement with non-approved components will endanger the compatibility within the system and may affect the reliability and safety of the total system. It is recommended the user(s) attaching to this device must only use Miller retractable lifelines and approved compatible connectors.

- **LIFTING RINGS:** The lifting rings are to be used solely for lifting the unit up by crane or other means of a lifting or hoisting type structure to locate the unit on to the working surface. **Do not use the lifting rings for fall protection.**

- **MOVING THE SYSTEM:** Always disconnect before attempting to move the unit. Move the unit by using the horizontal handle at the rear of the unit using a pushing type motion. Steering the unit can be accomplished by using the handle located on the vertical boom. (Ref. fig.1) Never expose a worker(s) to a fall hazard by pulling the unit from the handles located on the vertical boom or from the anchorage points while connected to the unit.

- **INSTALLATION DISTANCE:** Minimum installation distance from the front of the unit to the leading edge is 2 ft. Minimum installation distance from the side of the unit to the side leading edge is 3 ft. (Ref. fig. 10)

- **CONNECTORS:** Connectors used within the system must be able to support a minimum of 5,000 lbs. Non-approved, non-compatible components may cause accidental disengagement (roll-out). Only self-locking, self-closing connectors are recommended by Dalloz Fall Protection.

- **SURFACE GRADE:** The Miller® Edge™ is designed for use on horizontal surfaces or surfaces ≤ than a 5% elevation. ***Warning: Do not use on surfaces greater than 5% elevation.***

- **WORKING DISTANCE:** The maximum working distance forward, measuring from the vertical boom is 26 ft. The maximum working distance from the side of the unit, measuring from the vertical boom is 12 ft. Ref. figure 10. ***WARNING: DO NOT EXCEED WORKING DISTANCE REQUIREMENTS.***

- **ANCHORAGE HEIGHT:** To determine the anchorage height of the unit measure from the eyebolt to the surface the unit is supported with. Ref. fig. 9.

II. INSTALLATION

Before installation, it is recommended that the support structure meets or exceeds requirements specified in General Requirements, Part B Limitations.

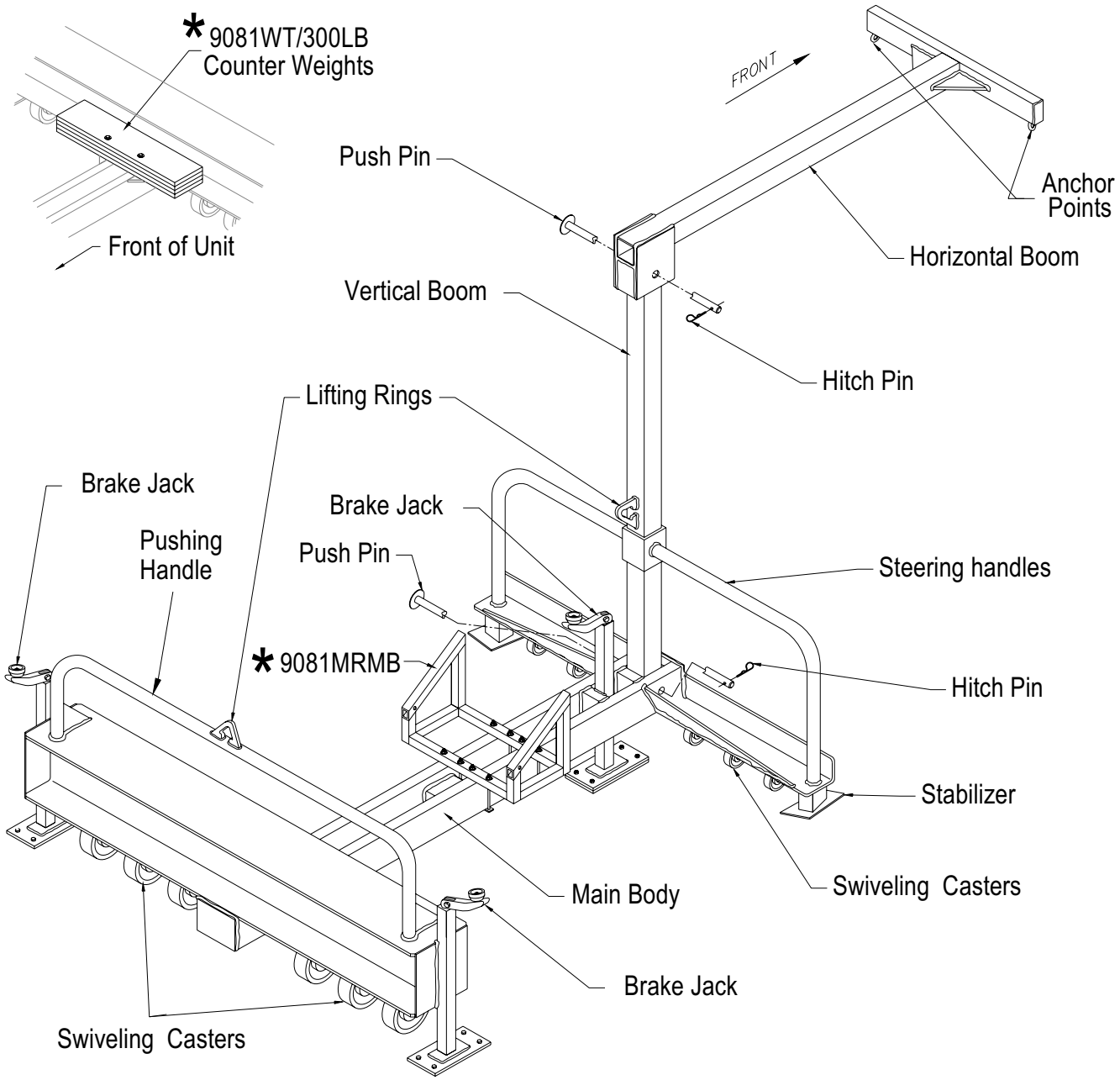
Before installation of this equipment, User must read and understand all instructions and carefully inspect all equipment to ensure that it is in usable condition. User should familiarize his/herself with all components of this system. Also, check for missing or damaged parts. Refer to inspection section for further details.

WARNING: Do not use if any damaged or missing parts are detected.

A. PART IDENTIFICATION:

*** Optional Equipment**

Fig. 1



B. SYSTEM COMPONENT INSTALLATION:

Unit Assembly Overview:

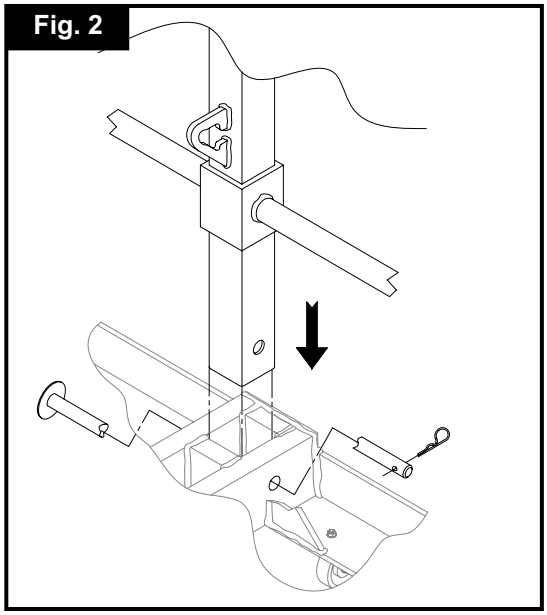
Step 1. Install Vertical Boom Assembly.
Step 2. Install Push Pin and Hitch pin.
Step 3. Install Horizontal Boom Assembly.
Step 4. Install Push Pin and Hitch pin.
Step 5. Inspect the installation and components of the unit before each use.

Unit Assembly Details:

NOTE: For safety and ease of assembly, it is recommended that two or more workers trained in the assembly and installation of the system assemble the vertical and horizontal booms.

Vertical Boom Installation: Refer to fig. 2. for typical installation.

Fig. 2



Step 1. With the Lifting Ring facing toward the back end of the unit, install the Vertical Boom down inside through the handle box and down inside the main body at the location shown in fig. 2.

Step 2. Install the Push Pin through the main body of the unit and ensure that the pin goes through both sides of the Vertical Boom and exits out the other side of the main body. Install the Hitch Pin.

WARNING: Ensure that the Hitch Pin has been installed through the Push Pin. DO NOT USE UNIT IF HITCH PIN IS MISSING.

Disassembly: Reverse above procedures.

Horizontal Boom Installation: Refer to fig. 3. for typical installation.

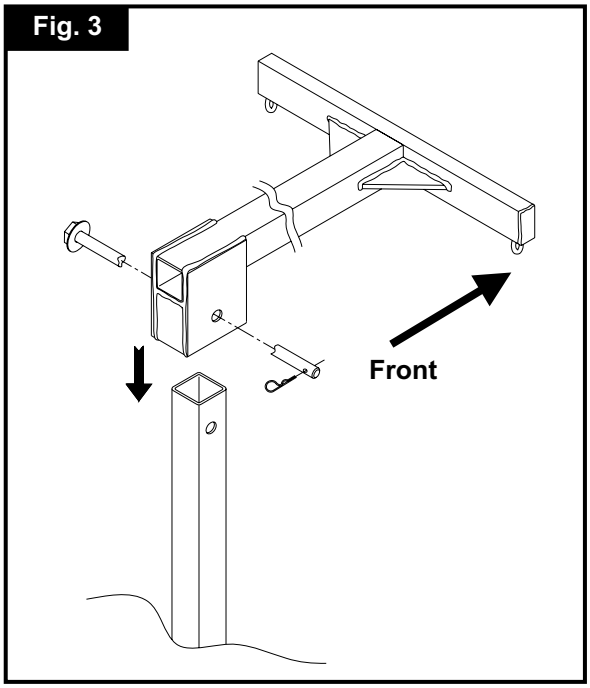
Step 1. With the anchorage points facing the front of the unit, place the Horizontal Boom over the top of the vertical boom as shown in fig. 3.

Step 2. Install the Push Pin through the horizontal boom and ensure that the pin goes through both sides of the Vertical Boom and exits out the other side of the horizontal boom. Install the Hitch Pin.

WARNING: **Ensure that the Hitch Pin has been installed through the Push Pin. DO NOT USE UNIT IF HITCH PIN IS MISSING.**

Disassembly: Reverse above procedures.

Fig. 3



B. SYSTEM COMPONENT INSTALLATION (cont.)

9081MRMB Installation:

Step 1. Locate the Installation marks stamped into the main frame rails located in the center of the unit. Ref. fig. 4.

Step 2. Align and center the back of the bracket with the installation marks. Ref. figs. 4 & 5.

Step 3. Install a flat washer on the bolt, feed the bolt through both holes of the bracket along each side of the frame rails. Ref. fig. 5

Step 4. Install retaining strap, flat washer and hex nut. Tighten until snug then add 1/2 turn. Ref. fig. 5. Caution: Over tightening will cause damage to retaining strap.

Warning: All bolts must be installed to the above procedures prior to use. Failure to install all hardware supplied could result in serious injury or death.

Note: Inspect for loose or damaged components prior to use. If any damage or loose hardware is detected do not use system.

Fig. 4

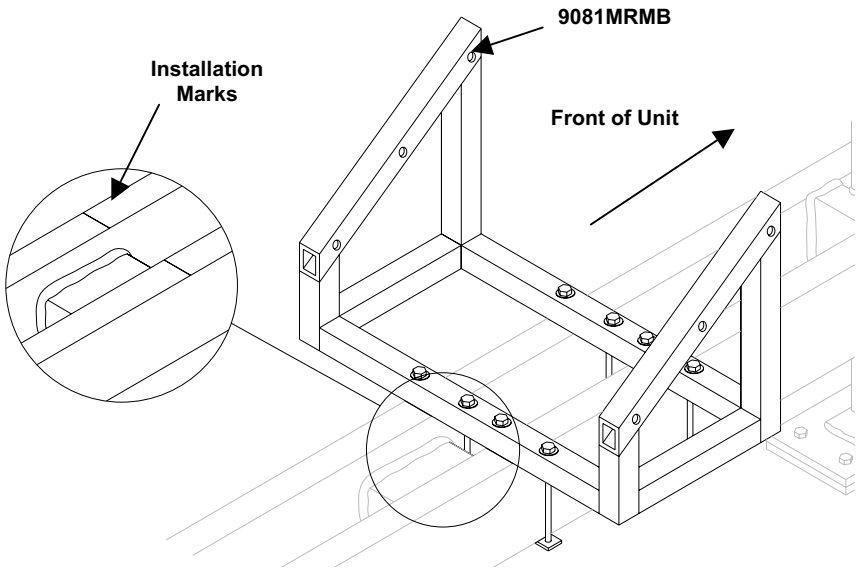
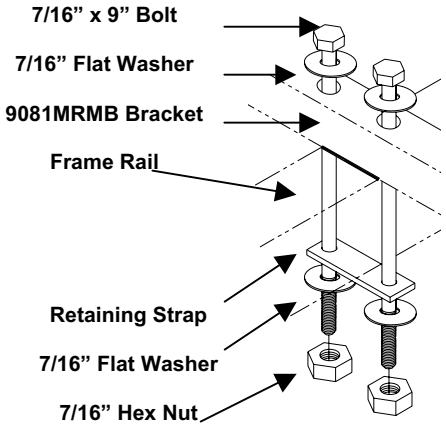


Fig. 5



Installing the MightEvac Retrieval Units to the 9081MRMB:

Step 1. Place the MightEvac with attached bracket to the 9081MRMB at the location shown and align the bottom holes. Ref. fig. 6

Step 2. Insert the bottom pin completely through both the bracket and the tubing of the 9081MRMB.

Step 3. Insert the second pin through the top installation hole of the bracket passing under the 9081MRMB bracket ensuring the pin is completely through both sides of the MightEvac bracket. Ref. fig. 6

Step 4. Open the pulley sheave by rotating half of the sheave. Place the cable on to the wheel of the pulley and close the pulley sheave.

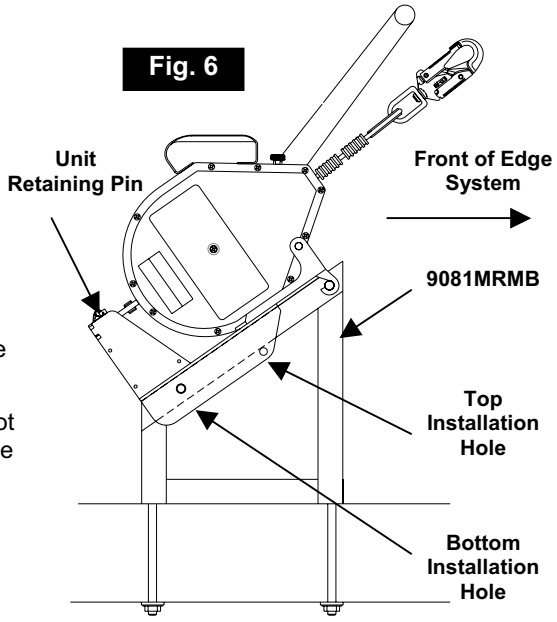
Step 5. Ensure that cable is ***over*** the steering handles of the Edge unit and not ***under,*** attach the carabiner to the pulley sheave and connect to the anchorage point. (Eyebolts) Ref. fig. 1

Disassembly: Reverse above procedures.

Warning: Both pins must only be installed at location shown. Failure to install pins at these locations could result in serious injury or death.

Note: Ensure the unit retaining pin is installed before using the system

Fig. 6



Installing the ManHandler Hoist

When standing behind Edge system the ManHandler can only be installed on the left side of the 9081MRMB unit.

Step 1. Place the ManHandler to the 9081MRMB at the location shown and align the top holes. Ref. fig. 7

Step 2. Insert the both pins completely through both the bracket and the tubing of the 9081MRMB.

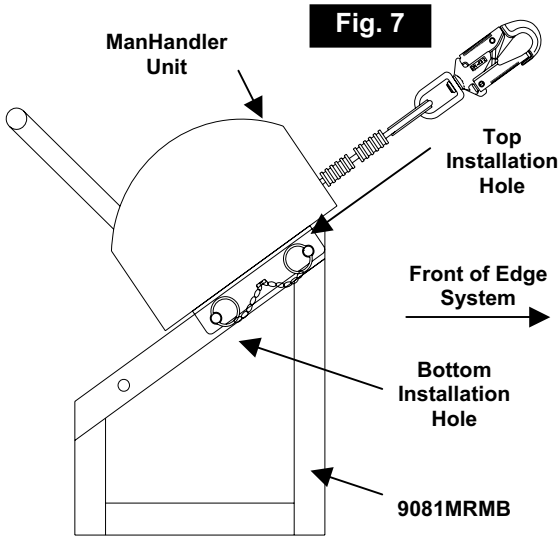
Step 3. Open the pulley sheave by rotating half of the sheave. Place the cable on to the wheel of the pulley and close the pulley sheave.

Step 4. Ensure that cable is ***over*** the steering handles of the Edge unit and not ***under,*** attach the carabiner to the pulley sheave and connect to the anchorage point. (Eyebolts) Ref. fig. 1

Disassembly: Reverse above procedures.

Warning: Both pins must only be installed at location shown. Failure to install pins at these locations could result in serious injury or death.

Fig. 7



Note: For operation and maintenance to the ManHandler follow instructions supplied with the unit at the time of shipment.

9081WT/300LB Counter Weight Installation:

Step 1. Locate the installation holes in the gussets in front of the I-beam. Ref. fig. 8

Step 2. Install the plates with (4) spacers on each side between the bottom plate and gusset. Ref. fig. 8

Step 3. Install a flat washer on the bolt, feed the bolt through the holes of each plate and through the gusset as shown in fig. 8

Step 4. Install flat washer and hex nut. Tighten until snug then add 1/2 turn. Ref. fig. 8

Warning: All (4) counter weights must be installed. Failure to install all counter weights may result in serious injury or death.

Warning: Counter weights must be used for units with anchorage points higher than 8 ft.To determine anchorage height reference fig. 9

Note: Inspect for loose or damaged components prior to use. If any damage or loose hardware is detected do not use system.

Fig. 8

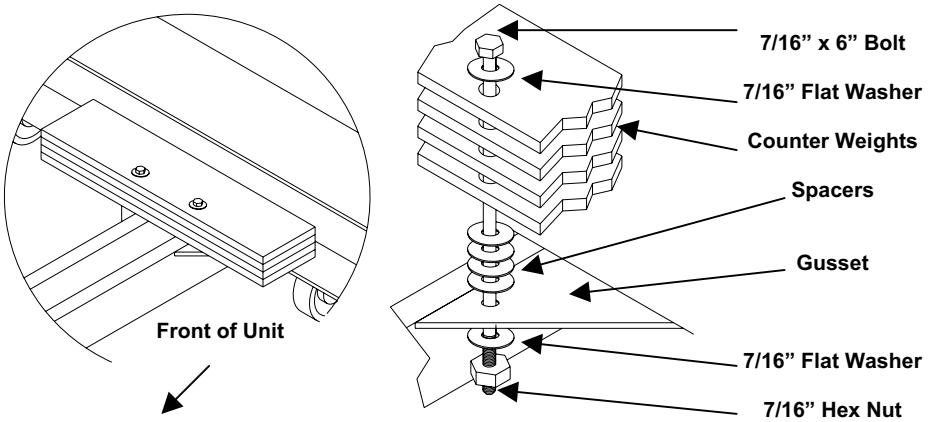
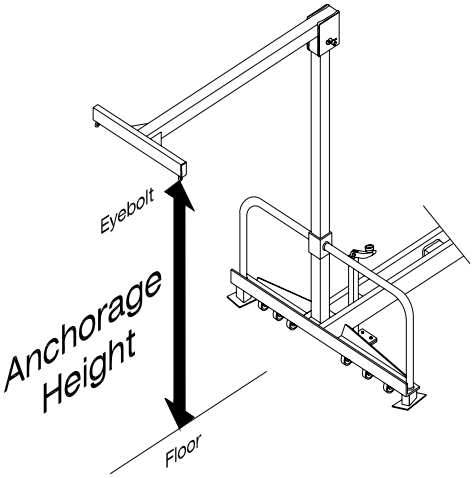


Fig. 9



Lifting the unit:

Before attempting to lift the unit, inspect to ensure the hitch pins are securely installed to the push pins. Lifting the unit is accomplished by using the Lifting Rings provided. Ref. fig. 1

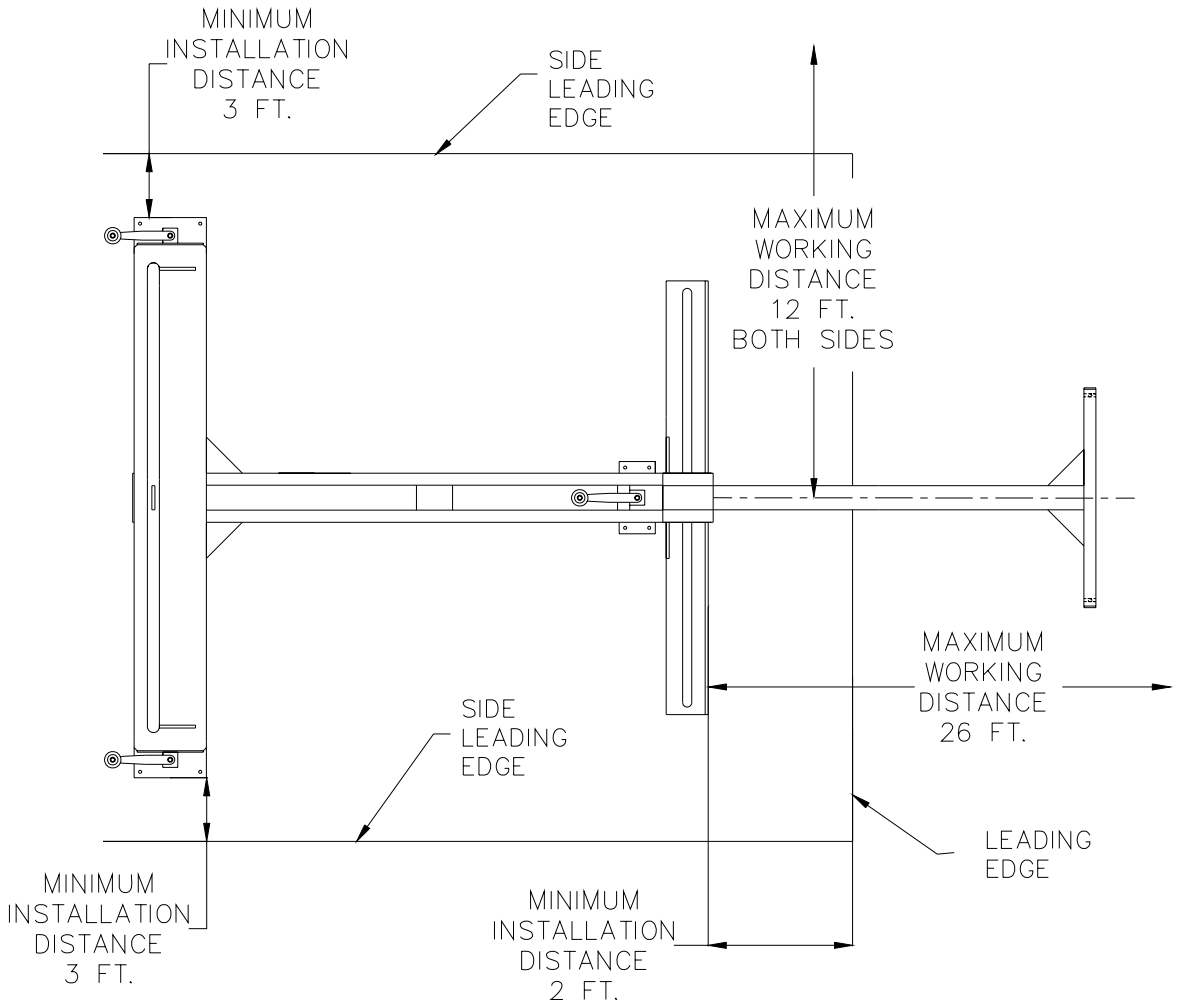
WARNING: Attempting to lift, raise or hoist the unit by using only one lifting ring or by using other areas of the unit is prohibited and may cause the unit to become unstable, unbalanced and cause the unit to fall or tip over causing serious or fatal injury. Never use Anchor Points to lift, raise or hoist the unit.

Warning: Do not use lifting rings for fall protection.

Installation Distance:

Once the unit has been installed at the desired location, ensure the unit has been placed at a minimum of (2) feet from the front of the unit to the leading edge of the work surface and (3) feet from either side of the unit to the side edge of the work surface. Ref. fig. 10. **WARNING: Do not use the system if installed less than the required distance from the edge. Failure to do so may cause serious or fatal injury should a fall occur.**

Fig. 10



Working Distance:

The working distance is the maximum distance a user can work away from the system while anchored to the unit. The maximum working distance forward, measuring from the vertical boom is 26 ft. The maximum working distance from the side of the unit, measuring from the vertical boom is 12 ft. Ref. fig.10. **WARNING: DO NOT EXCEED WORKING DISTANCE REQUIREMENTS.**

Unit Inspection:

After installation is complete, a final inspection of the system is required. Using a hand punch, designate the appropriate installation date and service/inspection dates using the spaces provided on the label. Attach the label to the unit with the nylon tie provided. Attach the label to the unit where it cannot be damaged and is easily accessible to anyone using the system. Record system identification information in the inspection and maintenance section of this manual. Do not remove the label from the unit.

III. OPERATION:

GENERAL OPERATION

1. Don a full body harness according to the manufacturer's instructions.

2. Once the installation and working distance requirements are understood and have been satisfied, lower each of the brake jacks completely by rotating the brake jack handle clockwise until each stops rotating. ***Warning: Be sure to lower each brake jack completely. Failing to do so could hinder the performance of the unit in the event of a fall and may cause serious or fatal injury.***

3. Install only Miller retractable lifelines and use personal fall protection according to the manufacturer's instructions supplied with that product. The personal fall protection used with this device must limit the fall arresting forces to 900 lbs. (4 kN) or less and be rigged to limit fall distance to within regulatory requirements and prevent the user from striking a lower surface in the event of a fall.

4. When the unit needs to be moved, disconnect each worker from the unit, raise each of the brake jacks completely by rotating the brake jack handle counter-clockwise. Move the unit by using the Pushing handle located at the rear of the unit. Steering the unit is accomplished by using the steering handles located on the vertical boom located at the front of the unit. Never expose a worker(s) to a fall hazard by pulling the unit from the handles located on the vertical boom or from the anchorage points while connected to the unit. *NOTE: Care should be taken when moving the unit on sloped surfaces.*

5. Once the unit has been successfully moved, lower each of the brake jacks completely by rotating the brake jack handle clockwise until each stops rotating. ***Warning: Be sure to lower each brake jack completely. Failing to do so could hinder the performance of the unit in the event of a fall and may cause serious or fatal injury.***

6. Connect to the system by using one of the anchorage points located on the horizontal boom. Connectors used within the system must be able to support a minimum of 5,000 lbs.(22 kN) Non-approved, non-compatible components may cause disengagement (roll-out). Only self-locking, self-closing connectors are recommended by Dalloz Fall Protection.

WARNING: Do not connect to any part of the unit that is not marked for use as an approved anchorage.

IV. TRAINING:

It is the responsibility of the user to ensure that they read, understand and follow all instructions and are trained in the care and operation of this system. Training should be repeated periodically and any time there is a change of components within the system. Training must be conducted without exposing personnel to any hazards.

V. INSPECTION:

Before each use, visually inspect for the following:

1. Inspect all components (i.e., wheels, anchorage points, jacks) for physical damages, cracks, wear, corrosion and workability.
2. Check all bolts for damages, cracks, looseness, wear, and corrosion.
3. Check to ensure that each push pin has been secured in place with a hitch pin and inspect for damage, worn, bent or broken parts.

4. Inspect for malfunctioning components, broken or missing pins and fasteners. Replace if necessary.
5. Inspect wheels to ensure that each rotates and moves freely and inspect for cuts, breaks, broken areas, excessive wear. Also, ensure that each wheel is securely fastened.
6. Inspect brake jacks to ensure that each works properly and is capable of raising the unit when crank handle has been rotated clock-wise to a complete stop.
7. Inspect all welds through out the unit for cracks, breaks, or corrosion.
8. Inspect system and all personal fall protection according to the manufacturer's instructions.

Formal Inspection: A competent person must perform an annual inspection of the entire system and all components.

> Note: If the system has arrested a fall, an evaluation of the entire system and components subjected to impact loading shall be immediately removed from service and shall not be used again for employee protection until inspected and determined by a competent person to be undamaged and suitable for reuse.

WARNING: If inspection reveals a defect in condition, immediately remove the unit from service.

VI. MAINTENANCE:

A. SERVICING
Servicing must only be carried out by a qualified person trained in the inspection and replacement of this system. The company safety officer should maintain a record log of all servicing and inspection dates for this unit. This unit and all components of the system must be removed from service if subjected to fall arresting forces. Contact Dalloz Fall Protection at 1-800-873-5242 if there are any questions.

B. CLEANING
Periodically clean the unit using a damp cloth and a non-abrasive mild soap or detergent. Towel dry.

C. STORAGE
Before storing, clean the unit to remove any dirt, grease or other materials that may have accumulated. Store in a clean dry area when not in use.

VII. WARNING LABELS:

ATTACH LIFELINE HERE

WARNING!

ONLY 1 PERSON PER ANCHORAGE IS PERMITTED AT ONE TIME. CONNECTORS USED WITHIN THE SYSTEM MUST BE ABLE TO SUPPORT 5,000 LBS. THE USE OF NON-APPROVED COMPONENTS MAY CAUSE SERIOUS INJURY OR DEATH.

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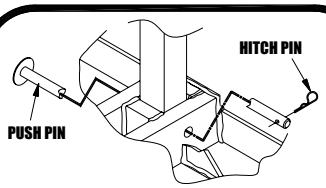
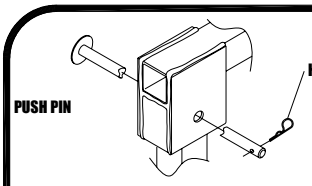


VERTICAL BOOM INSTALLATION

1. READ, UNDERSTAND AND FOLLOW ALL INSTRUCTIONS BEFORE USING.
2. INSERT PUSH PIN THROUGH THE FRAME, VERTICAL BOOM AND INSTALL HITCH PIN THROUGH PUSH PIN AS SHOWN.

WARNING: BE SURE THE HITCH PIN HAS BEEN INSTALLED. FAILURE TO DO SO MAY RESULT IN SERIOUS INJURY OR DEATH.

LB517 REV. A



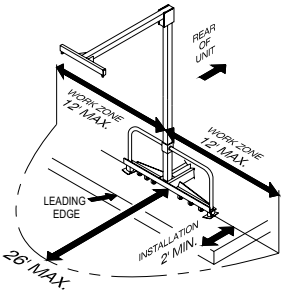
HORIZONTAL BOOM INSTALLATION

1. READ, UNDERSTAND AND FOLLOW ALL INSTRUCTIONS BEFORE USING.
2. INSERT PUSH PIN THROUGH HORIZONTAL BOOM AND INSTALL HITCH PIN THROUGH PUSH PIN AS SHOWN.

WARNING: BE SURE THE HITCH PIN HAS BEEN INSTALLED. FAILURE TO DO SO MAY RESULT IN SERIOUS INJURY OR DEATH.

LB516 REV. A

WARNING!
DO NOT EXCEED SAFE WORK ZONE
FAILURE TO FOLLOW MANUFACTURER'S INSTRUCTIONS MAY RESULT IN SERIOUS INJURY OR DEATH.



LB530 REV. A

LIFTING RINGS
BOTH LIFTING RINGS MUST BE USED TO LIFT THE DEVICE.

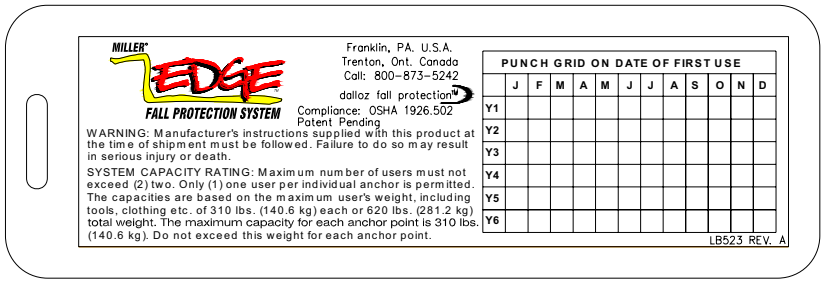
WARNING!
DO NOT USE FOR FALL PROTECTION.
USING ONLY ONE LIFTING RING MAY CAUSE THE DEVICE TO BECOME UNSTABLE OR UNBALANCED WHILE LIFTING.
FAILURE TO FOLLOW MANUFACTURER'S INSTRUCTIONS MAY RESULT IN SERIOUS INJURY OR DEATH.
LB518 REV. A

WARNING!
ENGAGED BRAKES BEFORE EACH USE. FAILURE TO DO SO MAY RESULT IN SERIOUS INJURY OR DEATH.

BRAKE ENGAGEMENT:
ROTATE BRAKE HANDLE CLOCK-WISE UNTIL HANDLE HAS STOPPED.

BRAKE DISENGAGEMENT:
REVERSE ABOVE PROCEDURES
LB520 REV. A

LB523



LB522

LB521

VIII. INSPECTION AND MAINTENANCE LOG:

DATE OF MANUFACTURE:_____

MODEL NUMBER:_____

DATE PURCHASED:_____

INSPECTOR:_____ **DATE:**_____

INSPECTION ITEMS NOTED:_____

_____

_____

_____

MAINTENANCE PERFORMED:_____

_____

_____

_____

Certificate of Test
9081 Miller Edge Fall Protection System

Issued by

Date Issued: 07/14/04

Bacou-Dalloz
1345 15th Street
Franklin, Pa 16323

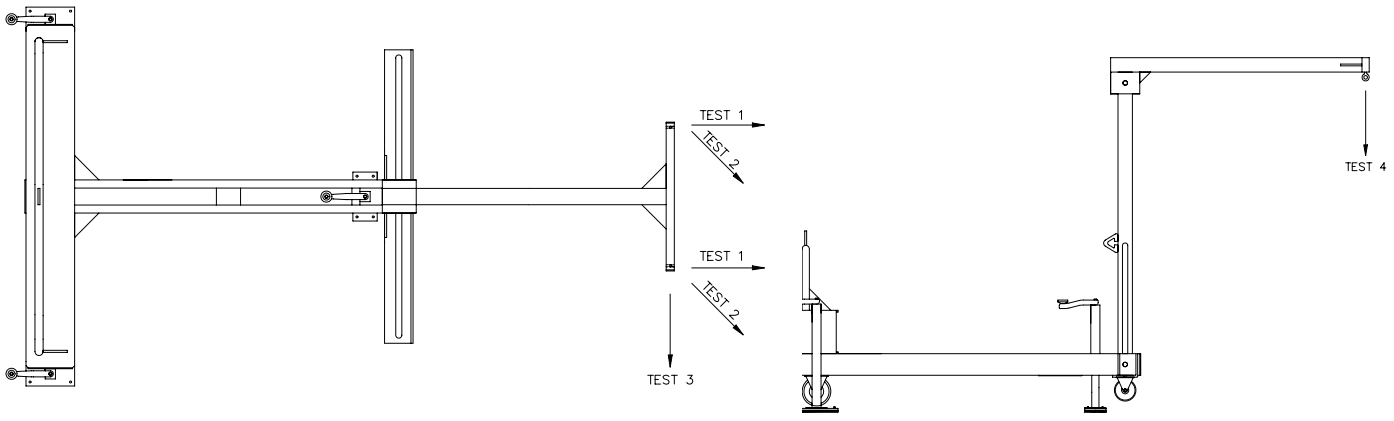
This is to certify that the Miller Edge Fall Protection System is in full compliance with the following test specifications.

PASS	FAIL	(The figure below illustrates each test direction.)
X		5/8” Plywood decking in each test direction
X		5/8” Plywood decking with a 5% slope in each test direction
X		5/8” Plywood decking with a 5% slope wet surface in each test direction
X		Perpendicular to slope in each test direction
X		Concrete flat surface in each test direction

TEST CRITERIA

Provide a 2:1 safety factor in the direction of load at the maximum recommended *Working Distance* on each type of surface mentioned above.

Simulates two users falling simultaneously but independent of each other.



Approved By: Chuck Ziegler **Date: 07/14/04**

Chuck Ziegler
Manager, Technical Support

SECTION 05520

PORTABLE RAILING SYSTEM

Display hidden notes to specifier by using "Tools"/"Options"/"View"/"Hidden Text".

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Portable, free-standing guardrail system for:
   1. Roof Railings
   2. Industrial Safety
   3. Loading Dock Safety
   4. Construction Safety
   5. Public Safety
   6. Skylight Safety
   7. Roof Hatches
   8. Crowd Control

1.2 REFERENCES

A. OSHA 29 CFR 1926.500-503.

B. OSHA 29 CFR 1910.23.

1.3 SUBMITTALS

A. Submit under provisions of Section 01300.

B. [Product Data]: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

C. Shop Drawings: Complete details of entire railing layout, showing member sizes and part identification, fasteners, anchors, fittings and evidence of compliance with structural performance requirements.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: minimum of 15 years experience manufacturing portable railing systems.

B. Installer Qualifications: 1-2 person crew capable of positioning base plates and installing portable railing systems according to manufacturers instructions.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Garlock Equipment Company; 2601 Niagara Lane, Plymouth, MN 55447. ASD. Te1: (800) 328-9522. Fax: (763) 553-1093. Email: sales@garlockequip.com Web: www.railguard.net

B. Substitutions: Not permitted.

C. Requests for substitutions will be considered in accordance with provisions of Section 01600.

2.2 DESIGN REQUIREMENTS

A. Structural Performance: Comply with requirements of applicable local, state, and federal codes.

B. Structural performance of top rails and supports:
1. Capable of withstanding a concentrated load of 200 pounds (90.6 kg), applied to the top rail at any point and in any direction.
2. Capable of withstanding a uniform load of 50 pounds per linear foot (74.3 kg/m) applied to the top rail horizontally with a simultaneous load of 100 pounds per linear foot (148.6 kg/m) applied vertically downward.
3. Design need not provide for both concentrated and uniform loads to be applied concurrently.

C. Structural performance of railing infill:
1. Capable of withstanding a horizontal concentrated load of 200 pounds (90.6 kg), applied to one foot (30.5mm) square area at any point on the infill.
2. Infill includes panels, intermediate rails, posts and other elements.
3. Design need not provide for infill loads to be applied concurrently with top rail loading.

2.3 MATERIALS

A. Railing Sections.
1. Rails: 1-5/8 inch (41 mm) O.D. by 0.065 inch (2.7 mm) wall HREW tubing.
2. Length: 5 feet (1524 mm).
3. Length: 7 feet 6 inches (2286 mm).
4. Length: 10 feet (3048 mm).
5. Height: 42 inches (1067 mm).
6. Mid-rail: weld to posts at 21 inches (533 mm) below top rail.
7. Finish: Epoxy powder coated safety yellow.
8. Finish: Hot dipped galvanized.

B. Gate System.
1. Rails: 1-5/8 inch (41 mm) O.D. by 0.120 inch (2.7 mm) wall HREW tubing.
2. Length: 4 feet (1219 mm).
3. Length: 5 feet (1524 mm).
4. Length: 10 feet (3048 mm).
5. Height: 42 inches (1067 mm).
6. Mid-rail: weld to posts at 21 inches (533 mm) below top rail.
7. Finish: Epoxy powder coated safety yellow.
8. Finish: Hot dipped galvanized.

9. Support wheel: positive locking mechanism with ability to swing right or left.

C. Base Plates.
1. Material: cast iron class 20B.
2. Size: 1 foot 9-1/2 inches by 1 foot 9-1/2 inches (546 by 546 mm).
3. Carrying handles: built in with a center carrying hook for base transporter.
4. Toeboard receptacles: two, built in.
5. Capacity: two railing sections and be able to accommodate adapter to support three or four intersecting rails on the same base.
6. Holes: Holes for permanent mounting and round holes for pins securing base to rail.
7. Bottom of base must have a concave recess no less than 125 sq. inches (806 sq.cm) to reduce rocking on uneven surfaces.
8. Base plate must provide no less than 5 inches (127 mm) of leading edge substrate contact as concentrated load is applied to base.
9. Finish: Epoxy powder coated safety yellow.
10. Finish: Hot dipped galvanized.
11. Four adhesive pads with directional non-skid resistant ridge pattern and minimum 28 sq. inches (180 sq.cm) of substrate contact each: shall be adhered to the bottom of base plate to resist slippage on hard surfaces.

D. Securing Pins.
1. Material: 1038H cold rolled steel.
2. Lock: Klick-pin attached to chain to lock into pin shaft.
3. Finish: Electroplate and zinc dichromate dipped.

E. Service Cart.
1. Cart shall attach to the Garlock Little Giant 4 Wheel Trailer. Little Giant Trailer shall have built-in wheel brakes.
2. Cart shall be able to carry eight base plates and seven rail sections.
3. Cart shall have a manual winch to raise and lower base plates.
4. Cart shall be able to carry base transport, eight short Speed Boards, and six long Speed Boards and a cabinet for holding the securing pins.

F. Speed Boards.
1. Material: 4 inches (102 mm) wide, zinc plated steel.
2. Attachment: Boards shall telescope to fit into toe board brackets on base plate and pinned to the base toe board brackets.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Before installation, inspect all parts to insure no damaged parts are used.

C. Railing must be secured to base with securing pins.

D. Where there is a danger of falling materials onto someone below insert a steel Speed Board into the toeboard bracket on the base plate and secure with securing pins to base.

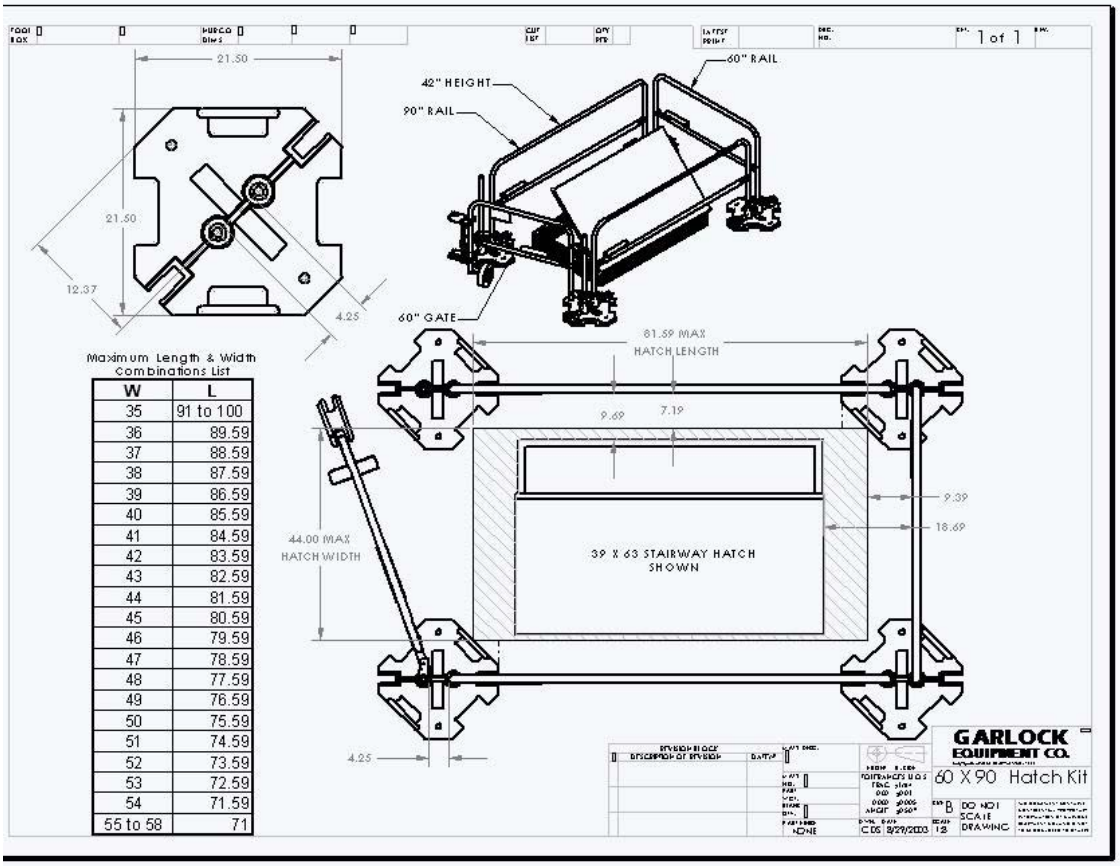
E. Use a Railguard 200 outrigger at any interruption in continuous railing sections. Outrigger assembly consists of a 5 foot railing (1.52 m) with base plate pinned to railing and placed 90 degrees away from danger side of continuous railing.

3.4 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION


1 of 1
21.50
21.50
12.37
4.25
42" HEIGHT
90" RAIL
60" RAIL
60" GATE
81.59 MAX
HATCH LENGTH
9.69
7.19
9.39
18.69
44.00 MAX
HATCH WIDTH
39 X 63 STAIRWAY HATCH
SHOWN
4.25
Maximum Length & Width
Combinations List
W
L
35
91 to 100
36
89.59
37
88.59
38
87.59
39
86.59
40
85.59
41
84.59
42
83.59
43
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48
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74.59
52
73.59
53
72.59
54
71.59
55 to 58
71
GARLOCK
EQUIPMENT CO.
60 X 90 Hatch Kit
DO NOT SCALE DRAWING

7.0 USE OF EXTERNAL SOFSTOP WITH SELF RETRACTING LIFELINES

Bacou-Dalloz Fall Protection
1345 15th Street
Franklin, PA 16323
PH: 800-873-5242

TECHNICAL BRIEF 102

Horizontal Use of Self-Retracting Lifelines

In reference to the above subject matter, Dalloz Fall Protection recommends that the Miller® brand of self-retracting lifelines (SRL's) be mounted to an overhead anchorage connector whenever possible and to a suitable anchorage point. However, due to the lack of an overhead anchorage, mounting the SRL's at or below the back D-ring of the users harness may be necessary. For these applications, the SRL is considered to be used for horizontal movement.

The following should be considered when mounting SRL's for horizontal applications:

- Exceeding a six foot free fall;
- An increased swing fall potential;
- The locking speed of the SRL may vary in the event of a fall due to friction between the lifeline and the platform edge;
- The SRL may lock up quicker than the workers walking pace and thus cause a fall by jerking the worker off balance;
- Excessive lifeline abrasion on work platforms and/or surfaces;
- Lifeline contact to sharp edges should be avoided;
- Lifeline may be pinched between two surfaces causing excessive lifeline wear and weakness.

During flat roofing, leading edge or similar applications, a suitable anchorage connector such as a temporary horizontal lifeline should be used to keep the SRL at or above the workers back D-ring and away from obstructions. Care should be taken when rigging the SRL so as not to impede the free movement of the lifeline. If the cable of the SRL has the potential to travel over the edge of a flat surface, the potential for cable sheer may exist. This is due to a 90^{o} bend in the lifeline, the sharp edge of a platform and fall arrest forces created by the fallen worker. For this application we would recommend a rubber bumper or padding around the sharp edge and the use of a Miller SofStop™ shock absorber (U.S. part no. 928LS) between the workers harness and the snap at the end of the Miller SRL. This will help protect the lifeline and reduce the impact forces in the event of a fall. Additional fall arrest clearance must be calculated to compensate for the deceleration distance (42 inches) that will occur when the shock absorber is deployed.

Please note that we do not normally recommend the use of a separate shock absorber in conjunction with SRL's. This recommendation is application specific due to the ability of the cable:

- To come in contact with the perimeter edge;
- To see a 90^{o} bend (this reduces the strength of the wire rope by approximately 50%);
- To see potential fall arrest forces in excess of the cable sheer strength (the SofStop shock absorber will keep the forces below the sheer strength of the wire rope).

As stated above, the potential for pendulum (swing) fall may exist for this application. It is the responsibility of the user and/or employer to be sure that contact with the lower level or with obstructions in the users path do not exist. Such hazards could cause serious injury or death.

Employee training on the proper selection, use and care of personal fall arrest equipment is necessary prior to using fall arrest equipment. The training should make the users aware of how to recognize existing and potential fall hazards and how to eliminate, prevent or control these hazards. Elimination could be in the form of engineering out the hazard, prevention could be a restraint or passive system and control would be the use of personal fall arrest systems. Training on identification of potential hazards that could result from the use or misuse of certain types of fall arrest equipment should also be covered.

1345 15TH Street
Franklin, PA 16323

June 20, 2006

Rick Zellen
Kiewit

Subject: Use of External SofStop with Self Retracting LIfelines

Dear Rick,

As stated in our Technical Brief 102, the use of a Miller 928 SofStop will increase worker safety when using self retracting lifelines in horizontal applications. Employee training should include all of the considerations mentioned in the brief, including the importance of padding over any sharp edges.

We have tested the FL11, Scorpion, Black Rhino and Falcon self retracting lifelines in horizontal applications. Testing shows consistent results no matter which SRL is used so, based on the results, our recommendation covers all Miller self retracting lifelines.

Additionally, we have tested our MightyLite and Titan series of self retracting lifelines in vertical applications with an attached 928 SofStop and this use is acceptable.

Because of the dynamics in a fall situation and the type of edge, radius of edge, and the material and hardness of an edge we cannot predict the force required to break a cable going over an edge. When using a 928 SofStop with a self retracting lifeline, the fall arrest force may exceed the ANSI requirement of 900 pounds but will not exceed the OSHA requirement of 1800 pounds.

Chuck Ziegler
Manager Technical Support
1-800 873-5242 ext. 1082

Kiewit

MEMORANDUM

DATE: June 12, 2006

TO: Project Sponsors
Project Managers
Job Superintendents
Project Safety Managers

FROM: Tom Skoro

CC: Parke Ball
Rick Zellen

SUBJECT: Use of External SofStop with Self-Retracting Lifelines

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Recent information shows the need for use of a Miller SofStop™ (U.S. Part No. 928LS) when using self-retracting lifelines (SRLs), due to the potential forces that could be imparted during a fall over a perimeter edge. Whenever possible, SRLs should be mounted to an overhead anchorage connector and to a suitable anchorage point.

Effective June 16, 2006, all uses of cable self-retracting lifelines (yo-yo's) require the use of the Miller SofStop. The Miller SofStop shall be installed between the workers harness and the snap at the end of the Miller SRL. Make whatever efforts are required to comply with this directive.

Employee training on proper selection, use and care of personal fall arrest equipment is necessary prior to using fall arrest equipment. The training should make the users aware of how to recognize existing and potential fall hazards and how to eliminate, prevent or control these hazards.

You may purchase the Miller SofStop by calling:

Sanderson Safety:
California (510) 559-8400
OR/WA (800) 547-0927

ORR Safety: (800) 669-1677

Please contact Rick Zellen at (360) 772-3978 for questions or assistance.

Thank you.

1345 15th Street
Franklin, PA 16323-0271
Phone: (800) 873-5242
Fax: (800) 892-4078

Memorandum

To: **Miller Distributor/End-user**

From: **Miller Technical Support**

Date: June 17th, 2004
Revised April 18, 2005

Lanyard Snap Hook and HLL Cable Compatibility

The information in the following paragraph applies only to Miller snap hooks with a throat opening no larger than ¾ inch.

Attaching a lanyard's / shock absorbing lanyard's snap hook directly to the cable of a Horizontal Life Line (HLL) system is an acceptable connection for single-worker fall protection. The cable itself is under tension keeping it relatively straight / taught, presenting very little risk of the possibility of connector "roll-out", should a fall occur. Additionally: The stanchion heads on intermediate supports utilized in BDFP multi-span HLL Systems have been specifically designed to offer a convenient "pass-through" feature so that workers will not have to disconnect-reconnect while traveling along the full length of the system (The lanyard's snap hook can be maneuvered "through" the head as the worker passes an intermediate stanchion).

Form snap hooks, also known as rebar or pelican hooks, which can have throat openings of 1 ¾ inches to 2 ½ inches are not approved for use on horizontal lifelines.