Risk Control Bulletin
Introduction to Fall Protection

RISK CONTROL

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Falls cost business owners millions of dollars each year in lost time, compensation, and third party lawsuits. However, with the right mix of pre-job planning, proper equipment selection and employee education and training, workers can continue to work at heights while limiting injuries and their associated costs.

There are a number of nationally recognized standards and legislative requirements that govern the use and need for fall protection. Typically, fall protection is required when working six feet above the level or obstruction below, or when a fall from a lesser height may result in a serious injury.

There are a number of important ingredients that must be included in any good fall prevention or protection program. These include identification of the fall hazards, implementation of a company policy, selection and use of the proper equipment and/or systems, and an in-depth training program including rescue.

Fall Prevention

The term fall protection encompasses a broad spectrum of techniques, equipment, and legislation in hopes to minimize injury and damage due to falls. However, where possible, a fall prevention approach should be taken to eliminate the fall altogether. Some examples would include engineering out the hazard by relocating a valve to a more accessible location, or utilizing site fall protection systems such as guardrails and floor covers, and using Fall Restraint Systems where possible.

Fall Arrest

Due to feasibility issues, cost and/or time restraints, fall prevention systems cannot always be used. For these situations, a fall arrest system can be used and can limit injury to a worker by stopping the fall prior to the worker hitting the level below.

Personal fall arrest systems are, at times, much more complex and require more detailed and comprehensive training to be effective and ensure safety. Further, the fall arrest system must limit the forces on the worker to less than 1,800 lbs.

Fall Protection Basics

All personal fall protection systems will incorporate some form of anchorage, body support, and connector(s), and should incorporate a plan for descent/rescue. In addition, there are a number of other factors that must also be considered including freefall and available clearance, anchor location and strength, shock absorption and potential for swing fall.

Body Support

The two most common types of body support used in the construction industry include the waist belt and full body harness. Both of these types of body support may be used for work restraint and positioning applications. However, if there is potential to fall (fall arrest) then only a full body harness should be used. A waist belt is banned for fall arrest and must not be used as it can cause serious injuries, has the potential to slip off, and limits suspension time.

Full Body Harnesses

The full body harness has significant advantages over waist belts including: prolonged suspension, distribution of impact forces, decreased potential for serious injury, upright suspension, and easier rescue. All American National Standards Institute (ANSI) approved full body harnesses must have an attachment point (D-ring) located between the shoulder blades (dorsal location) for use with other fall arrest equipment.

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Harness Types

Some harnesses have multiple attachment points for differing applications. Workers and supervisors should be aware that the harness of choice is one that is relatively simple, easy to adjust, and causes no confusion regarding the attachment point. The categories of harnesses are as follows:

- Fall Arrest
  - Back dorsal D ring
- Controlled Descent
  - Front D ring
- Confined Entry/Evacuation
  - Two D rings on shoulder
- Ladder Climbing
  - Front D ring
- Work Positioning
  - Two D rings at waist

Harness Do's and Don'ts

DO:

- Adjust the harness to fit snuggly. A harness that does not fit snuggly can cause serious injury and limit the tolerable suspension time following fall arrest.
- Wear the chest strap. If the chest strap is not done up you may fall out of the harness in a headfirst fall.
- Inspect the harness prior to use. A harness that does not pass the pre-use inspection should not be used.
- Use the keepers to prevent the webbing from sliding through the buckles and to tuck back excess webbing.

DON'T

- Leave straps dangling or leave the harness partially done up. If the unattached straps are forgotten about, they may be caught in machinery or the harness may fall off during fall arrest.
- Use a harness that has been previously used to arrest a fall. It must be discarded following fall arrest.

Donning a Full Body Harness

Lay the harness out on a clean, flat surface to ensure there are no tangles in the webbing and for ease in inspection. Place the shoulder straps on and secure all corresponding buckles. Adjust all straps and buckles so that the harness fits snuggly, but still allows free movement. Ensure the sub-pelvic strap is just below the buttock and the chest strap is across the chest at nipple height. Slide all keepers to their correct locations. Attach all other fall arrest equipment to the dorsal D-ring on the harness.

It is important to follow the manufacturer's direction for donning your particular harness, as donning procedure may change.

Connectors

Connectors include equipment that is used to couple the body support to the anchorage. They include hardware, such as snaphooks and carabiners, as well as software, such as lanyards and shock absorbers.

Snaphooks

A snaphook is a connector with a hook-shaped body that has an opening for attachment to a fall protection component and a self-closing gate to retain the component within the opening. Non-locking snaphooks must not be used in fall protection as they may unintentionally disengage (**rollout**) during operation.

The autolocking snaphook is the only type that should be used for fall arrest applications because it limits the hazard of rollout when used with a large D-ring. Other disengagement hazards include forced rollout, false connection, resting over a sharp steel edge and attaching two snaphooks together.

Carabiners

Carabiners have an oval shaped body with a gate on one side that may be opened to attach to a fall protection or rescue component. Steel carabiners are recommended because of their durability and strength characteristics. All carabiners should be of the auto locking variety to prevent rollout. Some carabiners come with a split pin or captive

eye to prevent side or cross-gate loading. They should be rated for 5,000 lbs.

Lanyards

Lanyards are used to connect the anchorage to the body support of a fall protection system. The three lanyard types are rope, webbing, and cable. **Note:** Cable lanyards are very static in nature and must be used with shock absorbers when used for fall arrest. Maximum lanyard length for fall arrest is six feet including the shock absorber. Lanyards should be long enough to ensure usability, while remaining as short as possible to minimize freefall distance. Some lanyards are made to be adjustable allowing widespread use.

Double tethered lanyards (two lanyards that are integrally connected at one end) are also available to provide 100% tie-off protection.

Lanyard Do's and Don'ts

DO

- Attach the lanyard directly overhead to minimize swing fall hazard
- Use the shortest possible lanyard for the job.
- Inspect the lanyard prior to use.

DON'T

- Use a lanyard if has been used to arrest a fall.
- Attach two lanyards together to make them longer, as it could cause rollout, and the freefall is unacceptable.
- Tie knots in lanyards; it reduces the strength by 50%.
- Girth hitch lanyards, it can cut the lanyard.

Shock Absorbers

A shock absorber is used to dissipate the energy of a falling worker and minimize the resulting forces on the worker and the rest of the fall arrest system. Shock absorbers are designed to tear or extend, to reduce the forces of a fall. To meet ANSI standards, they must keep the forces below 900 lbs. and not extend the fall to more than 42''. This potential elongation must be added to calculations of total fall distance to ensure the worker does not hit the ground. Even if a shock absorber is only partially deployed, it must be retired. If a lanyard is used for fall arrest, a shock absorber should always be incorporated.

Anchorages

Anchorages can be defined as secure points to attach a lifeline, lanyard, or any other fall protection or rescue system. Some examples include structural steel members, pre-cast concrete beams, and davit arms.

There are two classes of anchorages, certified and non-certified. Certified anchorages have either been designed or engineered specifically for fall protection, or are existing structures that have been tested, evaluated and/or approved for use. Certified anchorages should be identified with paint or special markings to ensure that they are only used for their intended purpose. Once certified, an anchorage should be added to a plant or site location list.

Non-certified anchorages (temporary or improvised) include existing beams, trusses and other suitably strong structures throughout a job site that are not practically certified. As a result, workers using non-certified anchorages must be thoroughly trained in their use and proper identification. A quick check would be to visually assess if the anchorage would be able to support a ¾ ton truck and, if not, don't use it! Inappropriate anchorages include fluid carrying pipes, electrical conduits, and handrails.

Strength Requirements and Freefall

Anchorages used for fall protection should be capable of supporting a load of **5000 lbs.** per worker, unless certified by a professional engineer who maintains a safety factor of 2. The impact force or maximum arrest force (MAF) is the peak dynamic load that results from a falling worker being stopped by the system. This force is dependent upon the workers weight, free fall distance and energy dissipation by the system, i.e., use of a shock absorber. The MAF allowable is 1,800 lbs. However, it can be upwards of 3000-4000 lbs. when a shock absorber is not used.

The free fall distance is the vertical distance from the location the worker started to fall from, to where the fall arrest system begins to slow the worker down. The maximum allowable free fall distance is six feet. To limit freefall, the anchorage should be located as high as possible above the worker.

Anchorage Connectors

An anchorage connector is attached or connected around the anchorage to aid in attaching the rest of the fall protection system. The most common types include slings which can be made of webbing or cable.

All slings must be rated for 5000 lbs. and should be long enough to entirely encircle the anchorage with room to spare.

There are many other types of anchorage connectors, including roof anchors, beam clamps, eyebolts, and shepherd's hooks. It is most important to follow all manufacturers' directions prior to using any anchorage connector.

Specialized Systems

Self-Retracting Lifelines (SRLs)

A self-retracting lifeline contains a drum wound line under tension that is anchored vertically above the worker. When attached to the dorsal D-ring of a harness, the worker may climb up and down unimpeded. In the event of a fall, the device will lock the drum and prevent the lifeline form paying out, thus arresting the fall. The lifeline of the SRL can be composed of cable, webbing or synthetic rope, and may range in length from 7 to 250 feet. Most units have a load indicator to show if the device was previously loaded or fallen into. If this indicator is deployed, the SRL must be returned for servicing. Some of the guidelines that must be followed when using SRLs include keeping the lifeline away form sharp edges, never clamping or knotting the line and not using this device on flat roofs or while on granular surfaces.

Vertical Lifelines

ANSI defines a Vertical Lifeline as a vertically suspended flexible line with a connector at the upper end for fastening it to an overhead anchorage, thus providing a path along which a fall arrester (rope grab) can travel. Vertical lifelines are typically composed of nylon or polyester due to their high strength and wear characteristics. Some things to understand when using vertical lifelines include watching for potential swing falls, keeping the rope away from sharp edges and heat sources, using the shorted possible lanyard to minimize freefall when climbing and mating the lifeline with the rope grab.

Static Versus Mobile Fall Arresters

Static fall arrester, also referred to as manual rope grabs, are designed to remain locked onto the lifeline until the worker manually disengaged the locking mechanism (squeezes the device). Static arresters are used widely for protection while on powered swing stages, as the worker does not require his hands to climb, thus limiting freefall. They are also used in roofing applications for fall restraint scenarios as they stay in place when locked, but provide movement when required.

Mobile Fall Arresters (also referred to as automatic rope grabs) are best used when hands free use is required, i.e., climbing communication towers. These rope grabs will follow the worker up and down along the lifeline, but arrest the sudden fall of a worker. To minimize fall distances, the fall arrester should be positioned above the worker when arriving at the desired elevation. Additional clearance should be factored to include line stretch and arrestor lock off.

Ladder Safety Systems

Ladder safety systems incorporate either a flexible cable or rail assembly permanently installed up the center of a ladder. A fall arrester or safety sleeve is connected to the cable or rail and provides free movement up and down the ladder when attached to the workers full body harness. In the event of a slip or fall, the sleeve will lock-off and arrest the falling worker in a relatively short distance, minimizing injury, as opposed to the use of a ladder cage. **Note:** These systems represent the only instance where workers will attach to the frontal attachment of the harness for fall arrest, since the means of connection is kept very short or less than 9 inches.

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Horizontal Lifelines

A horizontal lifeline consists of a cable or rope that is connected between two fixed anchorages at the same level and provides a location to connect other fall arrest equipment such as lanyards, SRLs. It is designed to allow horizontal movement and protection of workers, i.e., along the length of a railcar. Industry standards dictate that they should be designed by a qualified person (professional engineer). The resulting forces exposed to the two anchorages of a horizontal lifeline during fall arrest can be many times greater than those expected from a single anchorage. Furthermore, the fall distance will also be greater because of the additional sag in the line during fall arrest.

Equipment Care and Maintenance

Inspection

All fall protection equipment should be inspected by the user prior to each use. A detailed annual inspection should also be performed by a competent person. All other inspections should be performed as detailed by the manufacturer. If there is ever any sign of an unsafe condition or if the equipment shows signs that it has been used to arrest a fall, it should be immediately retired or sent to an authorized service center for recertification.

Software, such as lanyards and harnesses, should be inspected for cuts, burns, discoloration, excess dirt or wear, knots or other damage, and must have all labels present. Hardware such as D-rings and snap hooks should be free of cracks, corrosion, deformation, burrs, missing parts, or other damage and/or wear.

Care and Maintenance

All manufacturers' directions should be followed for proper care and maintenance. Most soft and hardware can be washed with mild soap detergent, water, and a rag. The equipment should be dried with a rag and left to hang, out of direct sunlight. Equipment should not be taken apart, modified or repaired in-house. Additional servicing should only be performed by factory authorized centers.

Logging, Identification and Storage

Records of all equipment should be maintained in a centralized logbook including serial number, date of purchase or recertification, and inspection dates. Each worker should also be issued a personal logbook for daily inspections. All equipment should be tagged or marked as recommended by the manufacturer for identification. The storage location should be a cool, dry, and clean environment, out of direct sunlight; a locker or tool crib is recommended.

Rescue and Escape

Rescue is the one component of many comprehensive fall protection programs that is most often overlooked. Workers who have fallen and are suspended in a full body harness may or may not be able to perform a self-rescue. Rescues do not have to be complicated and risky. For example, if a fallen worker can be accessed with a ladder or manlift, then this procedure should be used prior to using rope rescue techniques. Technical rope rescue operations can be quite effective and safe but require a great deal of training for personnel to acquire and maintain an acceptable degree of proficiency. Most important is that a plan and procedures are developed. Rescues should be as simple as possible while putting the fewest workers at risk. A site rescue team is often recommended.