PART I

REGULATORY CONSIDERATIONS, RESCUE PLANS, AND DEVELOPING A RESCUE CAPABILITY

CHAPTER 1

THE REASON FOR RESCUE

By the end of this chapter, you should understand:

- The role of regulatory requirements in fall protection.
- The role of voluntary consensus standards in relation to regulatory requirements.
- How to approach forming a comprehensive managed fall protection plan.
- The hierarchy of fall protection.
- Common types of fall protection.

Early one December morning, on a swing stage scaffold suspended 50 feet above an ore dock, two workers performed maintenance work. In preparing to move the scaffold from one location to another, they discovered that one of the cables was kinked. As one of the workers worked to remove the kink, a strap that secured the swing stage to the dock let loose, causing one end to swing out from the dock. The worker was launched from the scaffold, striking the base of the dock 50 feet below before falling into the water. His surprised co-worker reacted as quickly as possible, extracted himself from the scaffold, and rushed to the base of the dock, searching for some way to help his companion. Spotting an extension cord nearby, he used it to lasso his companion's arm as he called for help. He did his best to hold his co-worker's head above water with the makeshift rescue line until rescuers were finally able to retrieve the employee from the water, using a boat. But it was too late. The fallen employee was not breathing at the time of rescue, and was later pronounced dead.[1]

Organizations that employ workers at height have an obligation to protect those workers who are at risk from falling during the course of their work. This is true whether the employee is working in a manufacturing facility, construction, transportation, agriculture, or any other industry. Being protected from a catastrophic fall, however, is just the beginning. Post-fall rescue is imperative whether the worker has impacted the ground or a lower level, or remains suspended in his harness.

[1]United States Dept of Labor; Occupational Health and Safety Administration, http://www.osha.gov/pls/imis/accidentsearch.html, Accident: 200514313: Employee Is Killed In Fall from Scaffold into Water; Report ID: 0552700. Event Date: 12/06/2006.

Falls from Height: A Guide to Rescue Planning, First Edition. Loui McCurley.

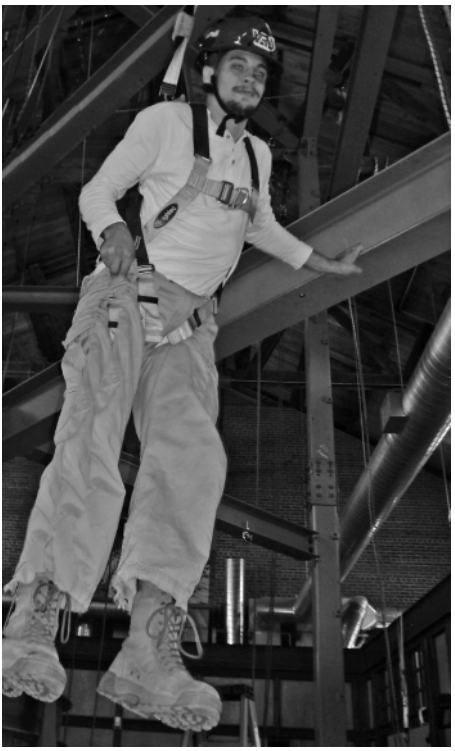


Figure 1.1 What does it feel like to be suspended after a fall?

Anyone who might harbor even the slightest doubt as to the importance of post-fall rescue for a suspended worker should engage in this simple little exercise:

1. Don a harness of the type that you/your workers normally wear.
2. Connect a lanyard to the harness in the manner in which it is normally used.
3. Connect the lanyard to an anchor that will allow you be suspended with your feet just at floor level.
4. Lift your feet so that you are hanging in the harness, as shown in Figure 1.1.

Within about 60 seconds, the importance of post-fall rescue will become crystal clear, without you even having suffered the effects of a fall!

Caution! This exercise should be attempted only under proper supervision by a qualified individual who is able to ensure immediate rescue. Always obtain your doctor's permission before engaging in this type of exercise.

REGULATORY REQUIREMENTS

In the United States, the obligation to protect employees stems from the Occupational Safety and Health (OSH) Act of 1970, which acceded regulatory authority for the workplace to the Occupational Safety and Health Administration (OSHA) and assigned them with a number of specific regulatory functions, among them:

1. Setting standards, and
2. Conducting inspections.

OSHA's specified purpose is "to assure . . . every working man and woman in the Nation safe and healthful working conditions and to preserve our human resources."[2]

As part of its mission, OSHA conducts inspections and issues citations to employers who do not provide adequate safety for their employees. Different types of violations can result in varying levels of financial penalties, with greater fines resulting from more serious violations. Violations deemed to be "willful" or "repeat" in nature can carry maximum fines up to ten times higher than serious violations. A *willful violation* is one committed intentionally, with foreknowledge or voluntary disregard for the law's requirements, or simply with indifference to worker safety and health. A citation for a *repeat violation* is issued when there have been previous citations for substantially similar violations at any work site owned by the same company.

The OSH Act was passed December 29, 1970, but OSHA did not come into existence until 1971. Since its inception, OSHA has developed numerous federal standards relevant to workplace safety and health. The standards cover four specific industries—construction, maritime, agriculture, and general industry—and are enforced throughout the United States. The term "standard" means something completely different when referring to OSHA standards as compared with voluntary consensus standards such as those developed by accredited standards-developing organizations. Because OSHA has enforcement authority, the standards (sometimes called rules or regulations) it sets have the force of law.

Employers who function under the laws of the United States are required to provide a safe and healthful workplace, as defined by these regulations, for their employees. OSHA monitors compliance to these regulations through inspections, whistle-blower programs, reporting requirements, and post-incident follow-ups.

Even in areas where OSHA has not identified a specific standard to address a particular hazard, employers are held responsible for employee safety under the Occupational Safety and Health Act's *general duty clause*. The general duty clause states that each employer "shall furnish . . . a place of employment which is free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees."[3] Falls are a recognized hazard, ranking among the top 10 federal standards with the most repeat violations cited by OSHA.

[2]OSH Act, Public Law 91-596, 84 STAT. 1590. 91st Congress, S.2193, December 29, 1970, as amended through January 1, 2004.

[3]OSH Act Section 5(a)(1).

Most other countries have some agency that serves a function similar to that of OSHA. In the United Kingdom it is the Health and Safety Executive (HSE); in Australia it is the National Occupational Health and Safety Commission (NOHSC); and in other countries there are other, similar agencies with other, similar acronyms. The regulations in each country differ from one another, so it is incumbent upon an employer working in a foreign country to become familiar with, and adhere to, the regulations of the country in which he is working.

Regulatory discussion is not a major focus of this book, but we will touch upon it to some degree as a foundation for the systems and methods discussed herein. Because this text is written in the United States, when the concept of governmental regulation of health and safety is referred to, it will be in context of OSHA. This is not to suggest that all readers from all countries should follow OSHA, it is only to serve as a point of reference. Readers from other countries are encouraged to further research their own regulatory authority (or authorities), with consideration to the concepts presented here.

Keeping workers safe is not just the law—it is also a good idea from a practical, economical standpoint. In 2009 alone, the Bureau of Labor Statistics logged more than 200,000 workplace falls. This, in turn, translates to billions of dollars in lost time, workers' compensation, litigation, medical costs, and so on. There is also the matter of worker morale to consider. No one wants to head off to work each day not knowing whether he or she will live to see another. Good employers know that safe, healthy workers are motivated, productive workers.

The category of potential workplace emergencies addressed by this text is that of fall-related incidents. Although we will briefly touch on some other specific hazards, employers with high risk exposure in these or other areas will want to consult industry-specific resources for solutions relevant to their particular application.

The majority of workplace falls are relatively simple slips and trips such as might occur on any walking surface. These types of falls are typically not catastrophic but are notable in that they may result in injury and/or time lost from work. These types of falls are important, but they are not the focus of this book.

Beyond the hazards of slips and trips on the horizontal dimension, many employers also employ individuals who work in or near the vertical dimension. This may include suspended work, scaffolds, elevated construction, large machinery, catwalks, container tanks, and other raised surfaces. Falls in these environments are much more likely to result in significant injury or even death. Falls that occur in this context, and more specifically, rescue of persons who fall while working in these types of environments, will be the focus of this book.

PROTECTING EMPLOYEES AT HEIGHT

OSHA regulations recognize that different employees may possess different levels of responsibility in the workplace. Workers may be held to different expectations, depending upon what level of responsibility the employer has bestowed upon them.

Throughout the regulations, the designations of Authorized, Competent, and Qualified are used to describe the differences. Although not all users of this manual will adhere to OSHA standards, these designations will be used throughout, as they are particularly useful in discussing different levels of responsibility.

As a general rule, the term "Authorized Person" refers to an individual who is approved or assigned by the employer to perform a specific type of duty or duties or to be at a specific location or locations at the jobsite. The term "Competent Person" is used in reference to one who is capable of identifying existing and predictable hazards in the surroundings or working conditions that are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

The term "Qualified Person" is a bit more of a loaded term. In regulatory-speak, it means "one who, by possession of a recognized degree, certificate, or professional standing, and/or who by extensive knowledge, training, and experience, has successfully demonstrated the ability to solve or resolve problems relating to the subject matter, the work, or the project." At this writing, there is a slight but meaningful distinction between the construction rules and the general industry rules in the United States. The powered platform (general industry) section states "one who, by possession of a recognized degree, certificate, or professional standing, *and* who by extensive knowledge . . ." while the construction rule states "one who, by possession of a recognized degree, certificate, or professional standing, *or* who by extensive knowledge . . ." (emphasis added by author).

Some OSHA standards present additional specific requirements that must be met by the Authorized, Competent, or Qualified Person(s), and the same or similar terms are also used by many standards throughout the world, usually in a similar manner. These concepts are foundational when planning any work at height, and any written documentation should specify what level of authority/responsibility the employer has designated to specific individuals for specific functions.

It is entirely possible—and even quite likely—for a person to be designated by their employer as an Authorized, Competent, or Qualified Person for one particular aspect of a job (such as fall protection, hazardous materials, or machinery operation), but not for other areas that pose different hazards or that require compliance to different regulations. On the other hand, it is possible that a given person might possess all of the experience and training necessary to allow him or her to be designated by the employer as an Authorized, Competent, or Qualified Person for every aspect of the entire jobsite. The more likely scenario is somewhere in between. A given person may be designated in one or more areas of the job as a Competent Person and as an Authorized Person in other aspects of the job.

In the United States, there is no single OSHA standard that establishes all of the specific responsibilities of Authorized, Competent, and Qualified Persons, but references to these appear throughout OSHA rules, standards, directives, and interpretations. Some of the OSHA standards list very specific requirements for qualification, tasks, and/or responsibilities, while others make only passing references. It is imperative that employers and safety professionals diligently research the regulation(s) that might apply to their type of work and environment to ensure that all requirements have been met for all levels of their employees.

Understanding employer and governmental regulation as it applies to fall protection for employees can be difficult, and this difficulty is compounded by the many different types of work and different kinds of fall hazards that may be present in the workplace. Additionally, OSHA has what it calls *duty requirements* that specify when an employer must have fall protection and other requirements that describe the criteria and practices that must be followed for each type of fall protection system used. However, it is simply not possible to organize fall protection, much less post-fall rescue, into a neat set of specific rules that fit all situations. OSHA acknowledges this difficulty when it separates its rules for fall-protection into one set of requirements for general industry, and another set of requirements for construction.

Federal rules for fall protection in the United States' construction industry are addressed primarily by OSHA in 29 CFR 1926.500 to .503, while fall-protection rules for general industry are found primarily in 29 CFR 1910.23 and 29 CFR 1910.132. It is important to note that it is the work being performed, not the job title, that determines which rules apply. Therefore, construction trade workers who are performing maintenance or general industry work would be held accountable to the applicable parts of the general industry standards found in 29 CFR 1910, and vice versa. In addition, 29 CFR 1910.66 has rules for fall protection when working on powered platforms, including both the duty to use fall protection and the criteria for personal fall arrest systems.

In accordance with U.S. federal regulations, as a general rule fall protection must be provided if an employee can free fall 4 feet or more onto a lower level in general industry or 6 feet or more onto a lower level in construction. This includes (but is not limited to) the following situations:

- When an employee is on a walking/working surface that has an unprotected side or edge.
- When an employee is constructing a leading edge.
- When an employee may fall through a hole in the walking/working surface.
- When an employee is working on the face of formwork or reinforcing steel.
- When employees are on ramps, runways, and other walkways.
- When employees are working at the edge of an excavation, well, pit, or shaft.
- When employees are working above dangerous equipment (even employees working fewer than 4–6 feet over dangerous equipment must be protected).
- When an employee is performing overhand bricklaying and related work.
- When an employee is performing roofing work on low-sloped roofs.
- When an employee is working on steep roofs.
- When an employee is engaging in precast concrete erection (with certain exceptions).
- When an employee is engaged in residential construction (with certain exceptions).

Already you can see that the employer has a big job on his or her hands when it comes to figuring out which regulations apply to his or her workers, and when. The complexity is further compounded as fall protection within these categories is then divided into several different subparts, depending on the nature of work being undertaken. There are separate guidelines, for example, for fall protection during work on scaffolds, on certain cranes and derricks, in tunnels, on stairways and ladders, during steel erection, and so on. Some of these have slightly different height limitations, and there are even complete exclusions in some instances.

The logic behind these variations can seem elusive, until you understand the scope, breadth, and complexity of the OSHA mission. OSHA adopted many of its original fall protection standards (like the current subpart D) from national consensus standards. Let's use the "4 foot rule" as an example. OSHA's fall protection rule in general industry requires fall protection for employees whenever they are working at heights in excess of four feet. This rule, which differs from other corresponding rules in OSHA regulations, originally came from a 1932 American National Standards Institute (ANSI) standard, A12.1. ANSI A12.1 has since been updated (A1264), and much work has been done to substantiate the survivability of falls greater than 4 feet—yet OSHA's 4 foot rule remains.

This story illustrates the fact that although national consensus standards are reviewed periodically, and many have been updated, corresponding OSHA regulations have not necessarily followed suit at the same speed. It is much more difficult to change an OSHA rule than to change an industry standard. Revised or new OSHA standards are subject to a stringent rulemaking process (including public participation) which, along with active lobbying from special interest groups, can make updates a lengthy and tedious process. As a result, sometimes regulations are not updated at the same rate of progress as technology.

As this book goes to press, OSHA is revising its general industry fall protection rules to consolidate the rules in subparts D and I. It is hoped that this will simplify matters and help facilitate compliance.

STATE PLANS

Employees who work for state and local governments in the United States are not covered by federal OSHA, but the Occupational Safety and Health Act does mandate protection for these workers in states that have an OSHA-approved state program, usually referred to as a *state plan*. A state plan is a job safety and health program that is similar to OSHA regulation, but operated on a state rather than federal level. OSHA approves and monitors state plans to ensure that they provide adequately for employee health and safety. State plans, by definition, may implement rules that differ from federal OSHA requirements, provided that those rules are (to use OSHA's words) "at least as effective" as the corresponding federal rules.

State plans may address one or more areas of safety that correspond with federal OSHA regulations, so it is important that the employer take all potentially applicable rules into consideration, and strive for compliance with whichever

TABLE 1.1 U.S. States and Related Regions with Approved State Plans

Alaska	Maryland	Puerto Rico
Arizona	Michigan	South Carolina
California	Minnesota	Tennessee
Connecticut[a]	Nevada	Utah
Hawaii	New Jersey[a]	Vermont
Illinois[a]	New Mexico	Virgin Islands[a]
Indiana	New York[a]	Virginia
Iowa	North Carolina	Washington
Kentucky	Oregon	Wyoming

[a]Plans cover public sector (state and local government) employment only.

regulation(s) are most conservative—that is, those that are most protective of the worker. More information can be found at www.osha.gov.

At this writing, the regions listed in Table 1.1 have state plans. Four these states (Connecticut, Illinois, New Jersey, New York) and one U.S. territory (Virgin Islands) have OSHA-approved plans that cover public sector (state and local government) employees only. Private sector workers in these four states and the Virgin Islands are covered by federal OSHA.

Where state plans exist, typically they adopt standards identical to the corresponding federal ones. Those that do vary will often also promulgate additional standards covering hazards not addressed by federal standards. State plan states must conduct inspections to enforce their standards, include public (state and local government) employees, and operate occupational safety and health training and education programs. In addition, most of these states provide free on-site consultation to help employers identify and correct workplace hazards.

OSHA requires federal employees to be protected by an effective and comprehensive safety and health program. Executive Order 12196, Section 1–201, and 29 CFR 1960.16 require federal agencies to adopt policies and procedures necessary to provide a level of protection equivalent to that provided by OSHA standards and regulations. Although OSHA does not fine federal agencies, it does monitor federal agencies and responds to workers' complaints. The United States Postal Service (USPS) operates under OSHA regulations.

At this writing, categories of workers not covered by the OSH Act include: those who are self-employed; immediate family members of farm employers who do not employ outside employees; and those who are regulated by another federal agency (for example, the Mine Safety and Health Administration, the Federal Aviation Administration, or the U.S. Coast Guard).

It is the responsibility of the employer to be aware which rules and regulations apply to a given workplace. Where multiple potentially applicable rules appear to be contradictory, it is always best to take the most conservative approach. The scope of this text will discuss only federal OSHA rules for general industry and construction in a very broad sense. State-specific variances from OSHA will not be addressed,

nor will variations between countries. Do your homework and be very sure that your workplace health and safety program complies with the requirements of the country and jurisdiction in which you are working.

STANDARDS

Although OSHA has the statutory authority to develop, promulgate, and enforce occupational safety and health standards, they do not do so in a vacuum. The federal government recognizes the value of the consensus process in safety and health standards. In fact, when OSHA first started, it was required (under Section 6a of the act) to adopt national consensus standards for the first 2 years of its existence without rulemaking. This contributed greatly to the body of knowledge that was adopted at that time.

Today, OSHA still tends to nurture cooperative working arrangements with private organizations that develop voluntary national consensus standards on topics related to occupational safety and health. In fact, the National Technology Transfer and Advancement Act (NTTAA)[4] directs agencies to use national consensus standards instead of writing their own when possible. OSHA takes this even a step further: if the agency deviates from national consensus standards it is required under Section 6(b)(8) of the act to explain why.

OSHA's recognition of and cooperation with national consensus standards can be helpful to the employer because OSHA fall protection regulations tend to be very performance-oriented. That is, OSHA defines relatively broad, sweeping objectives for protecting employees from fall hazards. By necessity, methods for applying and achieving those objectives will vary depending on the environment and work-type, among other things, and OSHA appropriately leaves this topic to more narrowly focused industry-specific consensus standards such as those developed under the ANSI consensus procedures.

ANSI is an accrediting organization that oversees the development of standards by member organizations such as the American Society for Testing and Materials (ASTM) and the American Society of Safety Engineers (ASSE). These and other consensus standards-developing organizations bring industry professionals together to develop national consensus standards under the ANSI process, which helps to ensure representation from a variety of perspectives and interests. OSHA offers cooperation and assistance to these voluntary consensus standards efforts through technical assistance and resources, participation in selected standards development efforts, and sharing occupational safety and health research reports with ANSI to assist in its mission.

Some of the industry consensus standards that are used by employers to supplement OSHA Fall Protection Standards today include ANSI Z359 on fall protection equipment, ANSI A10 on safety requirements for construction and demolition operations, and ASTM E 2505 on rope access. These consensus standards are

[4]OMB Circular A-119 (63 FR 8545 [February 10, 1998]).

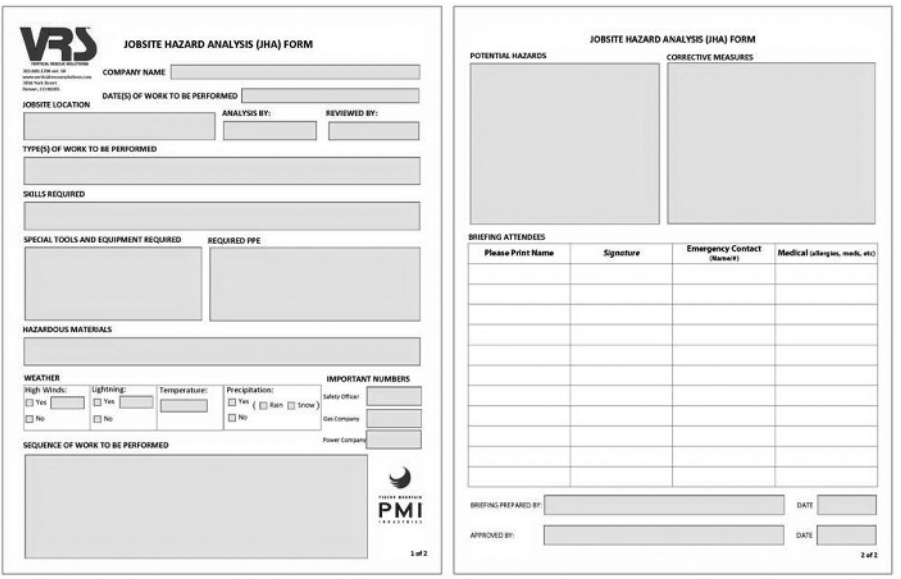
generally consistent with OSHA standards, but go into much greater technical detail regarding how to accomplish the requirements set forth by OSHA.

As an example, OSHA sets requirements for rescue after a fall. Specifically, OSHA's Occupational Safety and Health Standards in 29CFR 1910.66 App C Sect I (e) (8) Subpart: F, Personal Fall Arrest Systems states, "The employer shall provide for prompt rescue of employees in the event of a fall or shall assure the self-rescue capability of employees." To help employers achieve OSHA's mandate, ANSI Z359.2–2007 discusses the incorporation of rescue into the comprehensive managed fall protection program; ANSI Z359.4–2007 specifies performance requirements for assisted-rescue and self-rescue systems, subsystems and components; and ASTM E 2505–07 identifies partner rescue as a key part of a rope access program.

Employers must do research on current applicable regulations and standards to ensure compliance for their specific worker type and location. When in doubt it is best to err on the conservative side of interpretation. Employees must be protected not just from falling off a surface, but from falling through holes and from having objects fall onto them from above.

FALL-PROTECTION PLAN

Every employer who places workers at height should do so only under a written fall-protection plan. The fall-protection plan is a thorough treatment of fall hazards, and should not be confused with the job hazard analysis (JHA). A sample JHA form is shown in Figure 1.2.


JOBSITE HAZARD ANALYSIS (JHA) FORM

COMPANY NAME

DATE(S) OF WORK TO BE PERFORMED

JOBSITE LOCATION

ANALYSIS BY:

REVIEWED BY:

TYPE(S) OF WORK TO BE PERFORMED

SKILLS REQUIRED

SPECIAL TOOLS AND EQUIPMENT REQUIRED

REQUIRED PPE

HAZARDOUS MATERIALS

WEATHER

High Winds: ☐ Yes ☐ No

Lightning: ☐ Yes ☐ No

Temperature:

Precipitation: ☐ Yes (☐ Rain ☐ Snow) ☐ No

IMPORTANT NUMBERS

Safety Officer

Gas Company

Power Company

SEQUENCE OF WORK TO BE PERFORMED

PMI

1 of 2

JOBSITE HAZARD ANALYSIS (JHA) FORM

POTENTIAL HAZARDS

CORRECTIVE MEASURES

BRIEFING ATTENDEES

Please Print Name	Signature	Emergency Contact (Name/#)	Medical (allergies, meds, etc)

BRIEFING PREPARED BY: DATE

APPROVED BY: DATE

2 of 2

Figure 1.2 Sample JHA Form. Credit: Vertical Rescue Solutions/PMI.

A JHA provides a general overview of hazards while the fall protection plan goes into a thorough, detailed process that is intended to address all aspects of the work to be performed at height. The JHA, then, is but one part of a good fall protection plan. ANSI Z359.2 provides minimum requirements for a comprehensive managed fall protection program and is an excellent resource that provides formal guidance for developing a fall protection program.

A well-written fall-protection plan begins with a policy statement that is specific to the company writing it. This statement provides an overview of general goals and guidance for the managed fall-protection program and emphasizes management's commitment to providing a safe workplace for employees who are exposed to fall hazards. A policy statement might read something like the following:

> *(COMPANY NAME) strives to protect the health and safety of all employees. As a part of this policy, (COMPANY NAME) will equip, train, and expect employees to use effective fall-protection systems whenever exposed to a foreseeable fall hazard. (COMPANY NAME) also maintains an active program to make available self-rescue, assisted rescue, and professional rescue in the event of a fall.*

The fall-protection plan should go on to identify the employer's designated program administrator, as well as the person(s) involved in developing the fall-protection and rescue plans, respectively. The plan should be reviewed periodically, at a minimum whenever work practices, equipment, or other aspects of the program change.

FALL PROTECTION PLAN

A Fall-Protection Plan should include at least the following:

- Policy statement
- Name of program administrator
- Name(s) of responsible person(s)
- Fall hazard survey
- Fall mitigation plan
- Post-fall rescue plan.

The foundation of the plan is the fall hazard survey, which is a thorough, methodical identification of all fall hazards associated with an employer's workplace/practices. The fall hazards should be listed specifically and individually and described in as much detail as possible to facilitate safety and rescue planning. In some cases, a diagram or photograph of the location may be helpful.

In describing the location, be sure to consider how the location is typically accessed, the type of work that normally occurs in that location, persons potentially exposed (not just workers but also bystanders), height of potential fall, obstructions, and other potential hazards. It may also be helpful to consider any history of previous incidents in this (or similar) locations (if known), as this kind of information

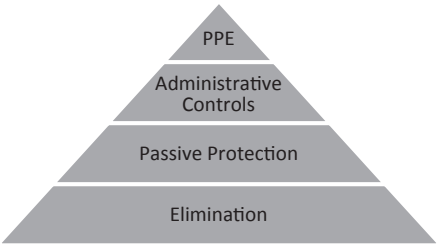


Figure 1.3 Hierarchy of protection.

can provide insight toward prevention as well as provision of safety and rescue. Understanding how likely an incident might be to occur, and how severe the potential consequences might be, will also help drive the response.

The next step is to determine how to best protect employees from each hazard identified. Some people automatically equate the term fall protection with fall arrest, but this is not accurate. Fall arrest is but one of many possible fall protection solutions. Protecting a worker from a fall may be accomplished by any of a number of methods, and employers should always opt for the safest practical means available. The "hierarchy of fall protection," illustrated in Figure 1.3, is a useful tool in determining order of preference. Using this approach, fall-protection methods are presented in an order that is presumed to preferentially provide the greatest safety, with the most desirable method forming the base of the pyramid and the least desirable method at the peak.

As illustrated by the hierarchy diagram, the safest means of fall protection is, of course, to simply eliminate the hazard. Colloquially called "elimination or substitution," in essence it simply means removing the hazard or hazardous work practices. In performing a given task, the employer should ask him- or herself, "Is there is another, safer, practical method that effectively accomplishes the task without placing an employee at risk of a fall?" If the answer is yes, the less risky method should be chosen.

Such elimination is arguably the most effective control measure for protecting employees from a fall in that this prevents the worker from ever being placed in the hazardous situation to begin with. Elimination of a fall hazard is usually achieved by changing a process, sequence, or procedure such that Authorized Persons are not exposed to the fall hazard. Lowering the work surface to ground level—as in lowering highway lights to the ground in order to change the light bulbs—is one example of substituting a work method in order to eliminate a fall hazard. In other words, *fall prevention* is a very effective method of fall protection.

Passive fall protection, the next preferred approach to fall protection, is another preferred method of fall prevention. The advantage of passive systems is that they generally do not require any special training or equipment on the part of the user. Passive fall protection involves isolating the worker from the hazard—for example, by means of a guardrail.

If a hazard cannot be mitigated through elimination or through passive methods, *Administrative controls* may be a good alternative. Administrative controls include processes that prevent a person's exposure to a fall hazard. Such controls

might include training, warning signs, lights or sounds, or other warning methods. American National Standard Z535.2, Environmental and Facility Safety Signs, contains standards for warning signs. One disadvantage of administrative controls is that they rely heavily on human behavior, management, and training. Once a person steps over the line in the example above, the immediate consequence is that he or she is exposed to the fall hazard. Under such a circumstance, if the worker *does* fall, fatal injury is likely.

The final approach to protection that should be considered involves use of Personal Protective Equipment (PPE). PPE may be the best solution available when a person must work at or near an edge, or in the vertical environment. Types of protection that utilize PPE include rope access, restraint/positioning, and fall arrest.

Rope access provides excellent protection, but requires specialized training and techniques for workers. Rope access methods utilize a redundant, two-rope system wherein one rope provides the "working surface" and the other provides "backup safety." In effect, it is like a positioning system backed up by a unique, secondary fall protection system—essentially resulting in dual protection. As a result, rope access facilitates safer access to the most challenging of worksites. Using specialized descending and ascending equipment, the worker can move from place to place in suspension to perform a wide variety of work. Rope access workers offer additional advantages in that they are usually highly trained above and beyond work procedures to also effect a self-rescue or partner rescue should the need arise.

Fall restraint is a different method, and involves securing (or tethering) the Authorized Person to a suitable anchorage using a lanyard short enough to prevent the person's center of gravity from reaching the fall hazard.

If rope access or fall restraint methods are not viable options, placing the worker at height and protecting him or her with a *fall arrest* system may be used. Fall arrest is a broad term encompassing a variety of systems designed to stop an Authorized Person after a fall has begun. Fall arrest systems range from fall arrest lanyards with force absorbers to self-retracting lifelines to vertical or horizontal lifelines.

The next few pages will discuss each of these types of fall protection in greater detail, with the goal of providing information that will improve the safety of the rescuer, as well as to his or her ability to render assistance to another.

FALL PROTECTION SYSTEMS FOR RESCUERS

Anyone who may find it necessary to rescue another from an industrial fall protection environment should first have a firm understanding of the various types of fall protection systems used by workers who may require rescue. Would-be rescuers should have a working knowledge of fall protection methods and equipment for their own safety, as well as for greater understanding of how best to achieve rescue in that environment.

The best method(s) of protection for the rescuer's safety in a given environment will most likely be the method(s) already in use there. A firm understanding of fall protection methods and systems will also enable the rescuer to be more

effective when rescuing another. What type of fall protection a fallen worker was using will have some impact on how the rescuer(s) are able to locate, access, and extricate him or her.

Passive Fall Protection

Clearly we have determined that workers who are exposed to a potential fall from height while working on a raised surface must be protected from falling by some means. Elevated work surfaces where work is frequent or ongoing may have a permanent or temporary fixed barrier installed around the edges of the platform and surrounding any open holes. These methods of protection are less likely to result in a worker being suspended and in need of rescue than restraint or fall arrest systems. For example, if a worker is not stopped by a railing, chances are they will impact the ground below and rescue will be a relatively simple matter of picking them up from the floor or ground.

This book will endeavor to focus on those types of fall protection systems—both passive and active—which are most likely to stop the worker in a manner or location where the worker may then be in need of rescue. Because barriers and handrails really do not fit this description, this book offers little attention to those methods. However, a few points are notable for rescuers who may be working in environments where such protection is present.

Barriers consist of passive systems such as a guardrail, parapet wall, or fencing. These are intended to provide a barrier to stop a worker from proceeding past the edge of a work level or into a floor opening, and to protect the employee from falling. One type of barrier that is common in many workplaces is the *guardrail*, which consists of a top-rail, mid-rail, and toe-board secured between vertical posts. A compliant guard rail must rise 39–45 inches above the walking/working level and must be capable of resisting at least 200 pounds force at any point along the rails, or if a higher load is anticipated it must be able to withstand that load. There must also be some sort of protection from falling between the rails such as siderails, screens, mesh, or intermediate vertical members.

Stair rails, used as a physical barrier on open stairs and ramps, are built to similar specifications as guardrails. Useful guidance for installation of guardrails, covering holes, and otherwise isolating hazards in general industry may be found in American National Standard A1264.1, Safety Requirements for Workplace Floor and Wall Openings, Stairs and Railing Systems, while similar guidance for construction may be found in A10.18.

Rescuers should note that while most properly constructed guardrails and stair rails offer sufficient strength for their normal, intended use, utilization of a guardrail or stair rail to anchor restraint, positioning, or rescue lines may not be adequate; in fact, some rules specifically prohibit tying off to guardrails.

Rope Access

Rope access is a specialized mode of access and protection that may be employed by specially trained, certified technicians to access hard-to-reach places in a variety

of industries. Rope access methods are often combined with conventional fall protection methods (restraint, positioning, arrest) to accomplish engineering inspections, maintenance work, installations, and other tasks in an efficient and comprehensive manner.

Rope access technicians rely on two ropes for access and protection: a primary line for ascending, descending, and traversing, and a backup line for safety. In this type of system, the fall protection offered by the second line is completely separate and independent from the primary means of support. The two rope systems are at once independent yet interchangeable, offering great versatility while maintaining continuous redundancy. Rope access methods are often, but should not be, confused with recreational pursuits such as climbing. This is an erroneous comparison in that recreational climbing is a sport whose focus is the personal challenge of the climbing endeavor, while in rope access, the focus is merely to safely reach a worksite for the purpose of performing a task.

Figure 1.4 shows a typical rope access system. Here you can see that the second line that is employed for backup safety in rope access differs from conventional fall arrest in several ways. First, in order for the secondary system to deploy, the very substantial primary system would somehow have to fail. With built-in fail safe mechanisms and extremely high safety factors, this is highly unlikely. Second, the backup safety system is rigged and managed in such a way as to preclude the extensive fall potential that is allowed in conventional fall arrest. Finally, the backup

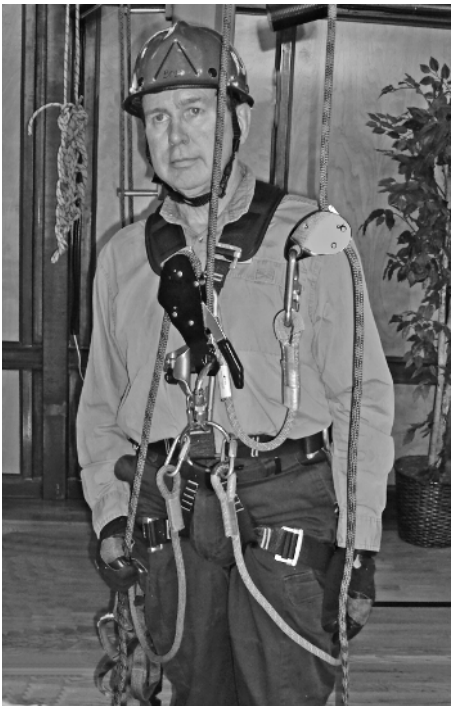


Figure 1.4 Rope access system.

safety system is much more dynamic than a conventional fall arrest system, and softens any potential impact with ease.

Rope access technicians are typically evaluated and certified by an independent third party organization such as the Society of Professional Rope Access Technicians (SPRAT). SPRAT is a consensus-driven membership organization that maintains industry-consensus standards on *Safe Practices for Rope Access Work* as well as on *Certification Requirements for Rope Access Technicians*.[5] These useful guidance documents are available from the organization's website at no cost.

Certified entry level rope access technicians typically receive at least 40 hours of initial training, and advanced certification requires extensive experience and verification of greater skill levels. Such extensive training and skills help prevent incidents from occurring, and in the unlikely event of compromise the certified rope access technician is almost always capable of self-rescue and partner rescue.

Fall Restraint

Restraint systems consist primarily of a safety harness or belt, a lifeline and/or lanyard, and a 3,000 pound capacity anchor. These are frequently used where work is being performed in a temporary capacity and/or where a fall arrest system is neither justified nor necessary.

A restraint system performs a little like a leash, and is intended to prevent the worker from reaching an edge where there is a risk of falling. In order to perform effectively, restraint systems must be rigged so that the worker is not capable of reaching a position where a fall might occur.

If the worker misuses the restraint system—for example, if the system is rigged such that the worker can extend his or her body weight beyond a leading edge—it might be possible for a worker to fall into the system and become suspended and in need of rescue. This is clearly a misuse of a restraint system, but planning for such an event may nevertheless be quite justified.

Fall Arrest

Personal fall arrest systems, such as that shown in Figure 1.5, should meet appropriate OSHA guidelines for construction (1926.502(d)) or general industry (1910), depending on the type of use. Normally, a fall arrest system will consist of at least a 5,000 pound capacity anchorage, lanyard, connectors, and a full body harness. Additional components, such as a rope, a fall arrester, and other equipment, may be incorporated into some systems.

A well-designed personal fall arrest system will prevent the user from a free fall greater than 6 feet (1.8 meters) and from contacting any lower level, and will

[5]Society of Professional Rope Access Technicians (SPRAT), 994 Old Eagle School Road, Suite 1019, Wayne, PA, 19087-1866. Http://www.sprat.org.

Figure 1.5 Personal fall arrest system. Credit: Tractel, Inc.

also limit maximum arresting force on the employee to no more than 1,800 pounds force (8 kilonewtons [kN]). At this writing, there is a general move toward reducing the allowable impact force by half, to 900 pounds force (4 kN).

Directly related to the concept of impact force is the matter of stopping distance. When a mass is in free fall and must be arrested, the energy generated by the falling mass has to go somewhere. That *somewhere* often involves force absorbers that extend in length when deployed, rope grabs that intentionally slip against a rope, and equipment that is designed to elongate under load. In fact, considering the allowable free fall distance, an allowable deceleration distance of 3.5 feet, and inherent elongation in the system, it is quite foreseeable that a person could easily end up well in excess of 12 feet beneath the original point from which they fell. This fact is of considerable importance to would-be rescuers.

Effective fall arrest guidelines may be found for general industry in ANSI Z359, or in ANSI A10.32 for construction.

Fall Arrest Using Self-Retracting Lifelines A self-retracting lifeline (SRL) is a specific type of fall protection device that may also be referred to by the monikers "retractable lanyard," "inertia reel," or "fall arrest block." Most SRLs consist of a lifeline (wire rope, webbing, or fiber rope) wrapped several times around a spring-loaded drum that is fitted with a centrifugal brake and encased inside a housing. Some SRLs are designed to be affixed to an anchorage above and in line with the worker, with the end of the lifeline attached to a fall arrest D-ring on his harness. Other SRLs (as shown in Fig. 1.6) feature the block fixed directly to the dorsal D-ring, with the line anchored above. In either case, as the person moves in a

Figure 1.6 One type of SRL. Credit: Reliance Industries, LLC.

controlled fashion the tensioned reel pays out and retracts, allowing the cable to travel but always with a slight bit of tension.

As long as the user moves in a smooth and controlled manner, the drum allows the lanyard to feed out and/or retract, maintaining light tension on the user. In the event of a sudden load, however (greater than 4.5 feet/second), the system locks up with less than 900 pounds force and 24 inches stopping distance. When tension is relieved on the system, the drum once again allows the SRL to move freely.

Fall Arrest Using Vertical Lifelines A vertical lifeline is a rope or cable that is suspended from an overhead anchorage point, as shown in Figure 1.7. Similar in function to the ladder safety system described above, it can be used in a free-hanging configuration, against a structure, on a ladder, with a suspended scaffold, or in any number of ways. A vertical lifeline is not just a device, but is a system, comprised not just of the vertical line itself but also a compatible fall arrest rope grab, connectors, lanyard, and harness.

With the worker connected to the vertical lifeline by means of a rope grab, as shown, the rope grab travels up and down the vertical lifeline as the worker moves in a controlled manner. In the event of a sudden load, such as a fall, the rope grab locks up and catches the fall.

Temporary vertical lifelines may be made of synthetic or wire rope. Permanent systems are usually made of rigid steel or aluminum rails, wire ropes, or similar materials. The fall arrester used must be compatible with the lifeline on which it is used. These can be very line-specific, and misuse can be catastrophic, so this is an important point. Most fall arresters are intended to be used with a force absorber, to help mitigate the impact of a fall. The safety harness is the final piece in the puzzle. This equipment is covered more thoroughly in Chapter 4.

Fall Arrest Using Horizontal Lifelines Horizontal lifeline systems are a versatile solution for work areas where overhead anchorage capabilities are limited, and

Figure 1.7 Vertical lifeline system. Credit: Reliance Industries, LLC.

may commonly be found on construction sites, roof tops, cranes, rolling stock, and bridges. Essentially, the horizontal lifeline serves as an anchor that facilitates horizontal mobility. The basic elements of a horizontal lifeline system, including anchorage, horizontal line, and PPE, are shown in Figure 1.8.

As in the case of vertical lifelines, the lifeline itself is but one piece of an overall system comprised of harness, lanyard, force absorber, and connectors, in addition to the properly anchored horizontal lifeline. The user connects to the horizontal lifeline by means of a lanyard, which travels across the horizontal lifeline as the user moves back and forth on the structure. Where distances are extensive or complex, multiple horizontal lifelines may be used, as shown in Figure 1.9.

A horizontal lifeline may be used for fall arrest or for restraint. Guidance for the use of horizontal lifelines for fall arrest may be found in 29 CFR 1926.502(d)(8) and there is also some useful information in Appendix C to Subpart M. The most important consideration is that these must be designed, installed, and used under the supervision of a Qualified Person as part of a complete fall arrest system that maintains a safety factor of 2. Because there are so many factors to consider with horizontal lifelines, an engineer often is needed. In the case of horizontal lifelines, it is always a good idea to keep the plan drawings and calculations because OSHA may want to see how the safety factor of 2 was determined.

ANSI 2359.17 (pending) is intended to provide some guidance for their construction. Horizontal lifelines that simply stretch between two points are referred to as single-span horizontal lifelines, while those that pass through intermediate anchorages are referred to as multi-span horizontal lifelines. Multi-span horizontal lifelines

Figure 1.8 Horizontal lifeline system. Credit: Reliance Industries, LLC.

Figure 1.9 Multiple, complementary horizontal lifeline systems. Credit: Reliance Industries, LLC.

may change direction at one or more points in the system. Some types of multi-span systems incorporate brackets and connectors that allow the user to pass intermediate anchors without unclipping, but in most cases workers must use multiple fall arrest lanyards, or twin leg lanyards, in order to effectively pass intermediate anchor points.

Fall Arrest on Ladders Elevated work spaces may be accessed by means of a fixed ladder. Requirements for, and appropriate protection of, a worker who is using a fixed ladder differ from those for a worker who is using a portable ladder, such as an extension or A-frame ladder.

Fixed ladders should ideally be provided with a fall arrest system to protect against a fall. Fall protection on a fixed ladder usually consists of a permanently installed vertical rail or wire rope system that is designed for use with an automatic fall arrest device. As the climber ascends/descends the ladder, the fall arrest device travels freely along the rail or cable. In the event of a fall, the device locks instantly to limit and arrests the worker's fall.

Ladder cages, such as the one depicted in Figure 1.10, may be found on some ladders, but these should not be considered to be a particularly effective method of fall protection.

While ladder cages may provide a means of support to a worker who might wish to lean against the barrier to rest, they cannot be relied upon to actually prevent or arrest a fall. In fact, anecdotal evidence and some research suggest that ladder cages may actually counter the proper function of fall protection systems (such as cables or rails) that are designed for ladders.

Figure 1.10 A ladder cage.

Figure 1.11 Twin lanyards. Credit: The Heightec Group Ltd.

If proper fall protection is not integrated into a fixed ladder design, the climber can use other methods to achieve complete fall protection. For example, the climber who is the first up the ladder may use twin lanyards, as shown in Figure 1.11, to alternately clip into the rails as he or she climbs.

Using this method, as the climber ascends one hook should be placed on one of the side-rails, as high above his or her head as he or she can comfortably reach. While it is also possible to place hooks on the rungs, generally speaking the side rail connection is much more secure and facilitates loading a stronger part of the ladder in case of a fall. When the climber reaches the hook, another hook is placed within reach of the other hand. Once the second hook is connected, the first hook may be removed. This process repeats until the climber has reached his or her goal.

Another possibility is to mount a vertical lifeline or a self-retracting lifeline to a fixed anchor at the top of the ladder. These devices (described in more detail later in this chapter) are utilized along with a full body harness and other components to secure the worker. More information on safety requirements for fixed ladders may be found in ANSI/ALI A14.3.

Fall Arrest on Suspended Work Platforms Where an extensive amount of work must be performed in a relatively inaccessible location, a suspended work platform may be used for employees to gain access. These may be either temporary or permanent in nature, and are commonly found on buildings where frequent access to exterior surfaces, such as windows, is anticipated. Suspended scaffolds (swinging scaffolds) are covered by OSHA in subpart D for general industry and in subpart L for construction, while powered platforms are covered by 1910.66.

Perhaps the most common type of suspended work platform used on buildings is the powered swing stage. Comprised of a work platform, guardrails, and a suspension system, these systems should meet OSHA 1910.66, subpart F. Powered platforms are usually raised, lowered, and leveled by means of one or more motors.

Workers using suspended work platforms should be protected against a fall from height by means of a separate fall arrest system. Although most of these devices feature guardrails, the scaffolds themselves are susceptible to failure due to mechanical malfunction, improper rigging, inadequate anchoring, overturning, collapse, damage, and wind. In these likely scenarios, a guardrail won't be much help. For this reason, fall arrest systems must be anchored independently of the suspended scaffold.

Window cleaners sometimes use a manually controlled miniature version of a suspended scaffold, also known as a boatswain's (bosun's) chair. The concept of the bosun's chair originated at sea. The term boatswain refers to a warrant officer who is responsible for operations on deck. A boatswain's chair, or bosun's chair, historically consisted of a wooden plank with stout lines passing underneath it and up into a bridle at chest level, and was used to haul a sailor up the mast on a halyard to do repair work or inspect the rigging.

Utilization of this tool in circumstances other than sailing was a natural development, especially in coastal regions where people had been exposed to sailing. Window cleaners, chimney sweeps, and even construction workers found a wide variety of uses for bosun's chair-sized suspended scaffolds in the workplace. These systems are typically used and regulated as suspended scaffolds, and should not be confused with rope access techniques.

Bosun's chair systems used in the workplace today have evolved toward improvements in comfort, weight, and strength, and nowadays usually feature a body support strap or straps to help prevent the user from slipping out. Figure 1.12 shows a modern bosun's chair. The movement of the suspended bosun's chair may be

Figure 1.12 Bosun's chair with safety straps. Credit: Tractel, Inc.

Figure 1.13 Rope access technician using a seatboard for comfort.

achieved by another person using a winch or a block and tackle system, or the person in the chair may also be able to raise/lower him- or herself utilizing a mechanical advantage system.

A vertical lifeline system typically protects the worker against a catastrophic fall, but this system does not offer the versatility nor the capability of rope access, nor is the level of training and skill possessed by users of these methods anywhere near that of a rope access technician. Victims of suspended scaffold failures, including bosun's chair failures, are often left dangling from a vertical lifeline by a dorsal attachment, and may be ill-equipped for self-rescue.

Note that the comfort seat used by some rope access technicians may, to the uninitiated, look a lot like a bosun's chair. However, there are some distinct differences between the two. While a bosun's chair really does function as a single point suspended scaffold and serves as the primary point of suspension for a worker, a seatboard is really nothing more than a comfort adjunct and does not serve as the primary source of security for the user (see Fig. 1.13). In a rope access system, the worker's harness is directly connected to the suspension system, so that he or she cannot inadvertently fall out or become detached. The seatboard is not the primary means of suspension, but is attached secondarily only for the purpose of comfort.

Fall Containment Systems

Where it is impractical to provide conventional fall restraint or fall arrest, *containment systems* such as safety nets are sometimes used. Although containment systems

may be considered "passive" systems by virtue of the fact that little to no special training is required of the user, they should not be considered to be equivalent of passive systems that *prevent* a fall, such as a handrail. Unlike a handrail, which is intended to prevent a fall from occurring, a fall containment system actually performs more of a *passive fall arrest* function.

Commonly found in bridge work and steel erection projects, safety nets should be installed as close as practicable, but no more than 30 feet, beneath the working surface.

Safety nets are used for a variety of applications, and because they may be as many as 30 feet below the level where work is taking place, rescue scenarios may be fairly complex. As an added challenge, openings in the net may be as large as 6 inches by 6 inches.

ANSI A10.11 provides guidance toward the design, installation, testing, and maintenance of safety nets, and OSHA guidance may be found in 1926.502(c)(1). Industry-specific guidance that is applicable to nets used on water tanks and communication and broadcast towers can also be found in 1926.105. OSHA requires that items that have fallen into safety nets be retrieved as soon as possible, but at least before the next work shift. This means that personnel may be accessing the nets to remove materials, debris, equipment, and tools—on a fairly regular basis.

Aerial Platforms and Man Baskets When there is no working surface on which a person might stand, one solution is for the worker to bring the working surface with them. Aerial baskets, bucket trucks, scissor lifts, and cherry pickers are all examples of mechanical lifts that may be used to temporarily raise a worker to an elevated position for the purpose of performing a task.

Aerial devices are the closest in appearance to a crane, consisting of a number of jointed sections that can be controlled to extend the lift in a number of different directions, often including up and over applications. This versatility permits users to reach locations that can pose particularly difficult rescue scenarios.

Aerial lifts may be powered electrically, or by gas or diesel engines. They may feature articulated arms that allow the basket to be manipulated in any number of directions and are designed with maximum lift limits of up to nearly a ton. Although an aerial lift is often designed to be set up and operated by just one person, this is generally not a good plan. Any work performed at height should always be done in teams of at least two.

Any worker using an aerial platform must be protected against a fall from the platform by means of a fall restraint system or a fall arrest system. While many aerials feature continuous handrails around the platform, they are generally also fitted with an identified anchor point to which a lanyard may be attached. With the safety system attached to the same device on which the worker is standing, catastrophic failure can occur. If the entire platform (or its support) fails or falls, the secondary system will go with it. While unavoidable, this situation does suffer from a lack of redundancy for safety.

Another concern with aerial work platforms is the possibility of the system becoming stuck, or of having to rescue a worker who falls from the work platform.

Some aerial platforms allow the user to bleed off pressure to accommodate rescue in such situations.

Exclusions

In some instances, employers may be able to claim an exclusion from the requirement to provide conventional fall protection. Such exclusions might occur where employees are engaged in leading edge work, precast concrete erection work, or residential construction work, and where it is demonstrated that it is infeasible or it creates a greater hazard to use conventional fall-protection equipment. Exclusions are touched upon throughout OSHA regulations, but the onus is on the employer to justify whatever decision is made.

The safety of the employee should always remain at the forefront of every such decision. Where an exclusion is claimed from conventional fall-protection requirements, the employer is *not* relieved from his or her duty to maintain a safe and healthful workplace. The exclusion simply allows that utilization of OSHA accepted standard practices may not be ideal; still, the employer is required to develop an alternative fall-protection plan that provides other measures to be taken to reduce or eliminate fall hazards for workers.

SUMMARY

Despite the significant effort that has been put into regulation and compliance, falls remain a leading cause of injury and death in the workplace. As we work toward mitigating these hazards, it is imperative to also maintain an ability to respond when an incident does occur.

Regulation in most countries mandates fall protection, and prompt rescue is also required. Some voluntary consensus standards seek to provide guidance and assistance in this process, but there is no substitute for formulating your own comprehensive managed fall protection plan that is specific to your workplace, and for specifying rescue personnel, methods, and equipment as part of that plan.

The remainder of this text provides guidance toward that end.

POST-CHAPTER QUIZ

Chapter 1

1. What is the name of the governmental agency that oversees occupational safety and health in your country?

a) Health and Safety Executive

b) National Occupational Health and Safety Commission

c) Occupational Safety and Health Administration

d) Other: _____

2. Which of the following is a *primary goal* of government involvement in occupational health and safety?

a) Fining employers for misconduct

b) Ensuring that employers provide a safe workplace

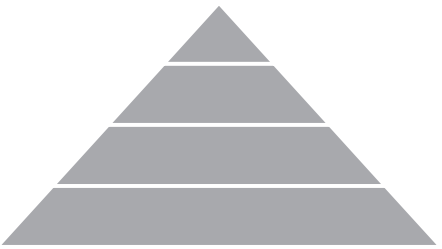
c) Reviewing employers' personal protective equipment

d) Developing state plans

3. Match the definitions for the following terms as they are used in this text:

Qualified Person	One who is capable of identifying existing and predictable hazards in the surroundings or working conditions that are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.
Authorized Person	One who, by possession of a recognized degree, certificate, or professional standing, and/or who by extensive knowledge, training, and experience, has successfully demonstrated the ability to solve or resolve problems relating to the subject matter, the work, or the project.
Competent Person	An individual who is approved or assigned by the employer to perform a specific type of duty or duties or to be at a specific location or locations at the jobsite.

4. Use words from the box on the right to fill in the blanks in the following diagram, starting with the most preferred method of fall protection at the bottom and the least preferred at the top.



Passive Protection
Administrative Controls
PPE
Elimination

5. True or False: The only way to effectively provide fall protection is through fall arrest.

6. True or False: Ladder cages can be relied upon to provide 100% fall protection.
7. A fall protection plan should contain the following parts (choose all that apply).
   a) Policy statement
   b) Name of program administrator
   c) Name(s) of responsible person(s)
   d) Fall hazard survey
   e) Fall mitigation plan
   f) Post-fall rescue plan
8. A horizontal lifeline may be used for
   a) Fall arrest only
   b) Fall restraint only
   c) Fall arrest or fall restraint
   d) None of the above
9. Guidelines for a comprehensive managed fall protection plan may be found in
   a) ANSI A14.3
   b) ANSI A10.48
   c) ANSI Z359.2
   d) ANSI Z359.4
10. Safety requirements for fixed ladders may be found in
    a) ANSI A10.48
    b) ANSI Z359.2
    c) ANSI Z359.4
    d) ANSI A14.3

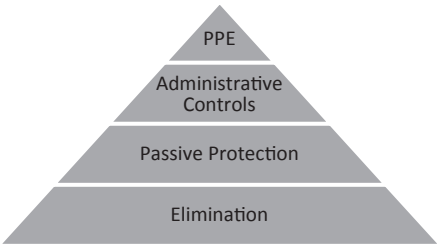
ANSWER KEY

1. Answer may vary
2. b
3. **Qualified Person:** One who, by possession of a recognized degree, certificate, or professional standing, and/or who by extensive knowledge, training, and experience, has successfully demonstrated the ability to solve or resolve problems relating to the subject matter, the work, or the project.

   Authorized Person: An individual who is approved or assigned by the employer to perform a specific type of duty or duties or to be at a specific location or locations at the jobsite.

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

4.



5. False

6. False

7. a, b, c, d, e, f

8. c

9. c

10. d