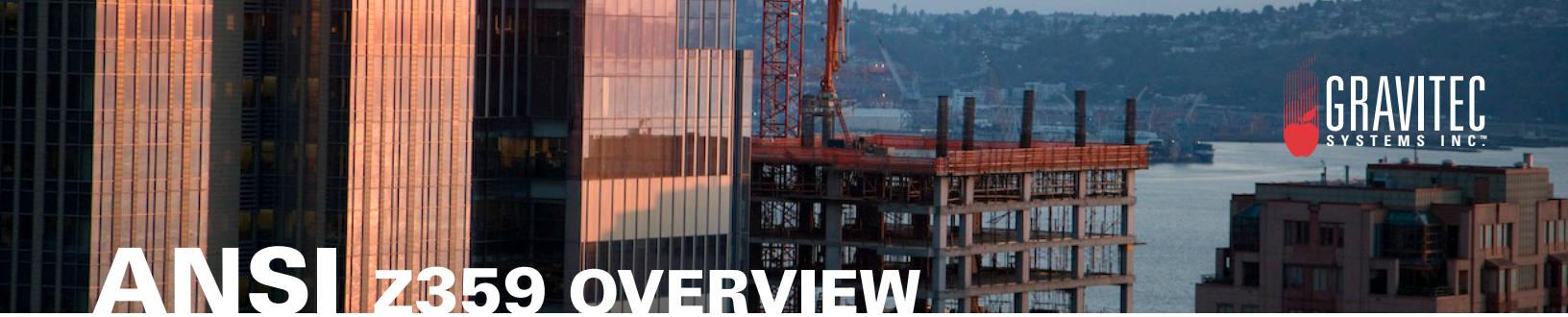

ANSI Z359 OVERVIEW

INTRODUCTION

ANSI Z359.1 was introduced in 1992 when standards for common fall protection equipment and methods in the workplace did not exist. That year 600 work-related falls resulted in fatalities, according to the Bureau of Labor Statistics (BLS). ANSI Z359.1-1992 made strides by addressing personal fall protection equipment and methods for arresting falls. The standard mandated the type and quality of equipment like full body harnesses and required self-closing, self-locking snap hooks. It also stated that fall protection systems must have a maximum arrest force of 4 to 8 kN (900 to 1800 pounds). Yet fatal falls in the workplace have continued to steadily increase since 1992. In 2006, 808 work-related falls resulted in fatalities, according to the BLS. This represents a 5 percent increase from the previous year and equals over two deaths per day on average. Revisions to Z359.1-1992 have been needed and anticipated. In 1999, the standard underwent minor editorial changes. Now, eight years later, some significant revisions have been made. Four new standards have also been drafted and approved, and the new code went into effect on Nov. 24, 2007. The Z359 family now goes beyond equipment and fall arrest to address managed fall protection programs, work positioning and work restraint systems and rescue systems. Yet, this is only the beginning. The current Z359 family is a living document and will continue to grow as twelve new subsections are drafted. As the individual standards are adopted, the Z359 code will be updated. What was once a 100-page document will swell in excess of 1,000 pages in the next few years.

Z359.0 – Definitions and Nomenclature

The first revision to Z359.1 involves the removal of definitions and nomenclature from the standard. Definitions and nomenclature from the code are now a new and separate standard under Z359.0-2007, which is devoted to standardized terminology. There are 150 specialized terms from sections one through four of the new standards. There is no charge for the definitions section when purchased with other sections of the fall protection code.

Z359.1 – Revising the Original Standard

For 15 years, ANSI Z359.1 has been the "benchmark" standard for fall arrest equipment. The revised Z359.1, titled "Safety Requirements for Personal Fall Arrest Systems, Subsystems and Components," still addresses fall arrest equipment with some important additions highlighted below.

It should be noted that this revised standard does not address the construction industry, window cleaning belts, and sports-related activities.

The revised standard addresses fall protection equipment and significant changes have been made to snap hook and carabiner gate loads. Under the original standard, gate faces must withstand 220 pounds of force and gate sides must withstand 350 pounds of force. The new standard requires that snap hook and carabiner gate faces withstand a load of 3,600 pounds. Additionally, the minor axis of the snap hook and carabiner gate must also withstand 3,600 pounds. These are significant changes that will make the connecting elements of fall protection equipment stronger and help prevent forced rollout, provided that compatible and proper connections are made. These new connectors must also be marked to distinguish them from existing equipment.

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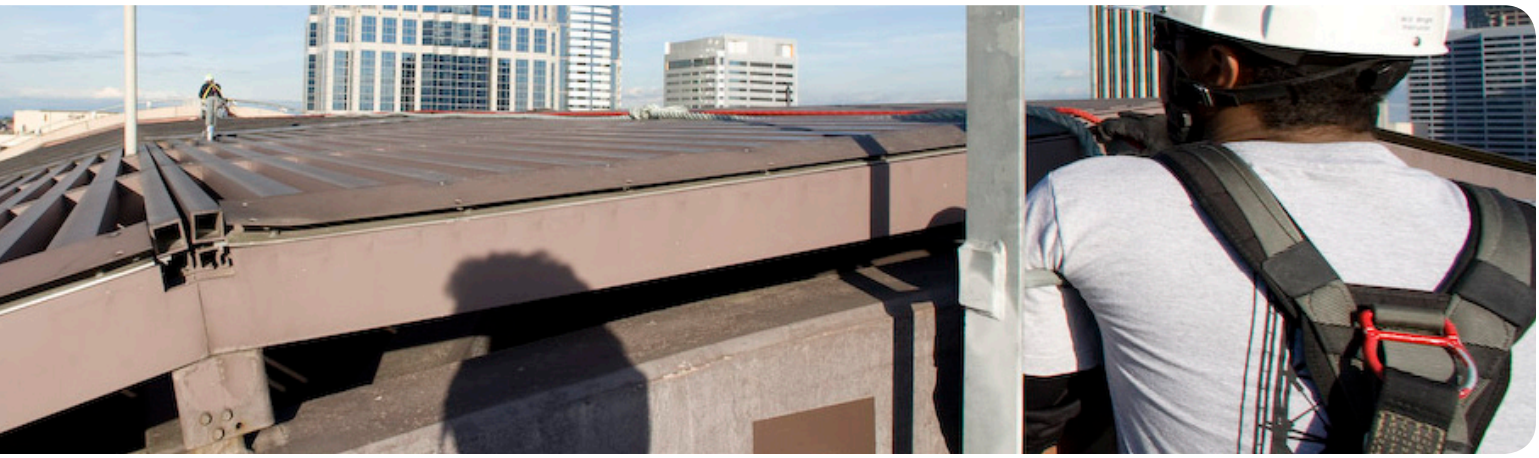

The front-mounted D-ring's capabilities have also been expanded in the revised standard. When located near the sternum area of the body, the front-mounted D-ring may now be used for fall arrest when the maximum free fall distance is limited to 2 feet (0.6m) and the maximum arrest force is 900 pounds (4.0kN). The original standard limits the front-mounted D-ring's uses to ladder climbing, fall restraint and work positioning and says that only dorsal (back) D-rings may be attached to a personal fall arrest system. The revised standard also includes static strength testing requirements for the front-mounted D-ring.

Twin-leg lanyards, not mentioned in the original standard, must now be marked with use warnings about proper connection points, permitted free fall distances, and positioning on the body. The revised standard also includes a 5,000 pound static test of the connection between the two lanyard legs.

According to the revised standard, anchorages must now withstand "two times the maximum arrest force permitted on the system when certification exists" or "5,000 pounds (22.2kN) in the absence of certification."

The standard also requires that harnesses and fall arrest systems be properly sized for the user; that connectors, snap hooks, and carbiners must be compatible with other equipment; that knots must not be tied in lanyards, lifelines, or anchorage connectors; and that vertical lifelines must be kept clear of hazards.

Training must address selection, inspection and use fall protection equipment, according to the new standard. This training must be communicated via multimedia, and trainers must be assessed at least annually to determine if their knowledge is current.

Finally, the new standard has undergone some editorial changes. The original standard says that straps, rope and webbing used in fall arrest systems must be made of "virgin synthetic material." In the new standard, they must be "made from synthetic materials on continuous filament yarns made from light and heat resistant fibers." Also, the term "user" has been further defined and substituted with "competent person," "qualified person," and "authorized person."

The 1.4 multiplier, referenced in ANSI Z359.1-1992 has been widely accepted as the multiplier between rigid test weights and humans in drop tests. Because most fall-arrest equipment's capacity is 310 lbs (the maximum allowable weight for a worker fully clothed and tooled), the multiplier compensates for the damping effect, or ab-

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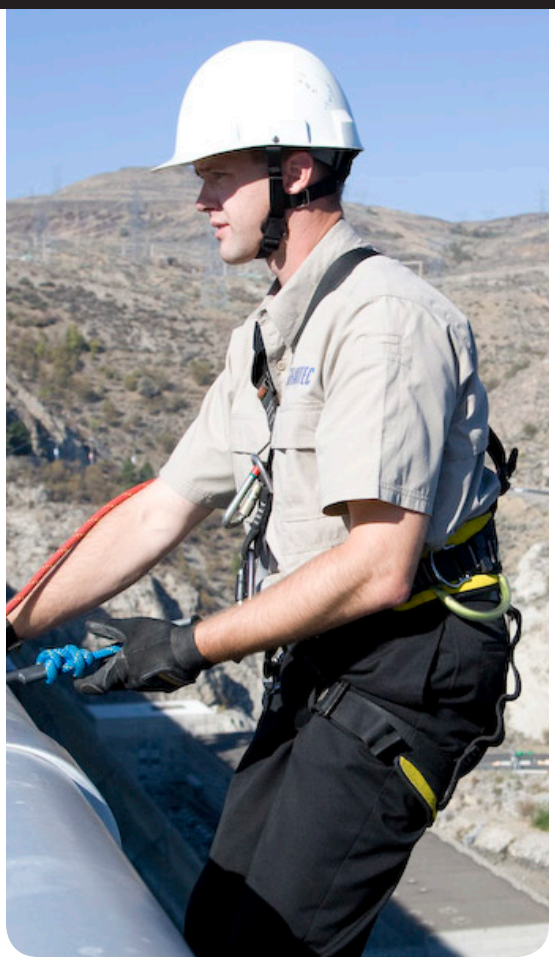

sorption, of a falling worker's body and ensures equipment is tested to maximum capacity. The formula is as follows:

220 lb Rigid Weight x 1.4 (force absorbed by dynamic human body) = 310 lb Fully Clothed/Tooled Worker

Other companies have conducted testing on this topic but Gravitec was the first to test the multiplier's validity using a documented scientific protocol. The results indicated that the 1.4 multiplier was not accurate when using a rigid weight to test fall arrest equipment, especially personal energy absorbers.

For more information about the 1.4 multiplier, visit the News Page on our website at www.gravitec.com.

Z359.2 – A Comprehensive Fall Protection Program

It is widely recognized that even with the best fall protection equipment and procedures, an at-risk worker who is not properly trained is still in danger of a fall. Z359.2, titled "Minimum Requirements for a Comprehensive Managed Fall Protection Program," is a new standard which outlines a detailed fall protection program aimed at safety, health, and environmental professionals and employers with one or more workers exposed to a fall hazard. The purpose of a comprehensive managed fall protection program is to 1) Identify, evaluate and eliminate (or control) fall hazards through planning; 2) Ensure proper training of personnel exposed to fall hazards; 3) Ensure proper installation and use of fall protection and rescue systems; and 4) Implement safe fall protection and rescue systems.

It should be noted that this revised standard does not address the construction industry, window cleaning belts, and sports-related activities.

The first stage in creating a comprehensive managed fall protection program is awareness from senior management and a commitment to fund the program. With a commitment from management, a policy statement supporting the program should be drafted and program participants identified. These participants are the employer, program administrator, qualified person, competent person, authorized person, competent rescuer and authorized rescuer. Their roles and responsibilities are clearly listed in the new standard.

The formation and training of a steering committee is the second stage in the process. This steering committee will identify and train the competent person and qualified person. These individuals must then prepare hazard surveys—the third stage in the process—for each fall hazard a qualified person may encounter. An organization may choose to bypass this step and hire an external contractor to prepare the hazard surveys.

Written fall protection procedures for every activity where a worker is exposed to a fall hazard can be generated from the hazard surveys. This is one element in the fourth stage of the process. One or more methods may

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be identified to eliminate or control fall hazards identified in the hazards surveys. The methods are ordered in a hierarchy as follows: 1) Elimination or substitution, where the fall hazard is removed; 2) Passive fall protection, where the workers are isolated from the hazard; 3) Fall restraint, where a worker is connected to an anchorage, preventing the worker from reaching the fall hazard; 4) Fall arrest, where a worker is connected to a system designed to stop a fall after is has begun; and 5) Administrative controls, where practices or procedures are designed to warn a worker before s/he approaches a fall hazard.

Stage four also includes the identification of training and equipment needs, policies and controls, and the planning of engineered systems. The new standard is also proactive by providing architects and engineers with guidelines to eliminate or control fall hazards during the facilities planning stage. Addressing fall protection at this stage of the game is more cost-effective.

Stage five involves program implementation. This stage involves the design and construction of engineered systems, purchasing of equipment and the development of materials necessary to train all employees who work at heights. Internal trainers may also be trained at this stage in the process.

Stage six addresses program maintenance. At this stage the employer is responsible for equipment and system inspections and servicing, accident investigations, ongoing training and program updates, and audits and surveys of the program.

The new standard outlines strength criteria for anchorage systems for fall arrest, horizontal lifelines, work positioning, travel restraint and rescue systems. All anchors will fall into two categories: 1) Certified anchors, which, through testing or analysis by nationally accepted engineering methodology, have been selected by a qualified person who documents and attests to their capacity; or 2) Non-certified anchors, which are judged by a competent person to be capable of supporting anchor forces prescribed by the standard.

The new standard also addresses rope access standards and procedures and requires that an evaluation of the area should be conducted where the rope access is to be used. It also requires that the system is used with a working line, a safety line and a full-body harness. The standard addresses maintenance and inspection and requirements for rope material. It says that the maximum fall distance for rope access connected to a dorsal ring is 6 feet and the maximum arresting force is 1,800 pounds.

Fall protection equipment be inspected by an authorized person at the beginning of every eight-hour shift, according to the new standard. Fall protection and fall rescue equipment must be inspected at least once a year by a competent person or competent rescuer and all inspections must be documented.

When a fall occurs, in-house rescue procedures or rescue provided by a professional rescue agency must be documented. If the rescue can be conducted in-house, then a rescue team must be trained and regular simulations conducted. If outside emergency services are used, these organizations must be involved before a rescue is needed and written strategies and procedures for rescue must be provided.

All incidents must be reported promptly to the program administrator and competent person and thoroughly investigated. The investigation should consider all contributing factors to the incident. Additionally, all equipment involved in the accident must be removed and inspected for damage. Incident reports must be maintained for five years.

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Ongoing evaluation of a comprehensive managed fall protection program by the program administrator ensures that the program will continue to improve as it evolves.

Z359.3 – Work Positioning and Travel Restraint

Z359.3, titled "Safety Requirements for Positioning and Travel Restraint Systems," is a new standard which outlines requirements for the design, manufacture and testing of personal work positioning and travel restraint equipment. These systems must not be used for primary fall arrest and must be supplemented with a secondary fall arrest system.

A positioning system is defined in Z359.0 as "a body belt or full body harness system configured to allow an authorized person to be supported on an elevated vertical or inclined surface, such as a wall, and work with both hands free from body support." A positioning system is intended to prevent a fall. A travel restraint system is defined in Z359.0 as "a combination of anchorage, anchorage connector, lanyard (or other means of connection), and body support that limits travel in such a manner that the user is not exposed to a fall hazard." Travel restraint systems are used only on walking/working surfaces with a maximum slope of 18.4 degrees.

The new standard says full-body harnesses used in these systems must meet the requirements of ANSI Z359.1 for fall arrest. Additionally, the D-rings on these harnesses must withstand a dynamic strength test with a 3-foot free fall by a 220 pound weight. Lanyards used in work positioning and travel restraint systems must be constructed of rope and webbing made of virgin synthetic material. They must also withstand a static load of 5,000 pounds. Lanyards and harnesses must have a breaking strength of 5,000 pounds.

Chain must be grade 80 alloy with a minimum nominal chain size of 9/32 inches (7.1mm) and chain fittings must meet or exceed the breaking strength of the chain size.

Buckles and adjusters must withstand a tensile force of 4,000 pounds (17.8kN). D-rings, O-rings and oval rings must withstand a tensile force of 5,000 pounds (22.2kN). Snap hooks and carabiners must requirements outlined in Z359.1-2007.

Z359.4 - Rescue

Z359.4, titled "Safety Requirements for Assisted-Rescue and Self-Rescue Systems, Subsystems and Components," is a new standard which outlines requirements for the performance, design, marking, qualification, instruction, training, use and maintenance of fall protection equipment and its removal from service. It addresses

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connectors, harnesses, lanyards, anchorage connectors, winches/hoists, descent control devices, rope tackle blocks, and self-retracting lanyards with integral rescue capability. The standard applies to one-person rescue systems with a capacity of 130 to 310 pounds (59 to 140kg) and two-person rescue systems with a capacity of 130 to 620 pounds (59 to 280kg). The rescue system must be connected to an anchorage or anchorage with anchorage connector that is compliant with Z359. All connectors must also comply with the requirements of the standard.

It should be noted that this standard does not apply to the construction industry, sport-related activities, rope access rescue techniques used by certified rescue technicians or other tasks that have established national consensus standards.

The new standard requires that the full body harness be statically tested to 3,600 pounds (16kN) and dynamically tested with a 2 foot free fall with a 220 pound test weight. They must meet the requirements outlined in Z359.1. Evacuation harnesses must fit snugly and may only be used for rescue, whether the rescue subject is conscious or unconscious, according to the standard. It must provide support around the body and shoulders at the very least.

A self-retracting lanyard component with integral rescue capability (RSRL) must be able to engage into rescue mode at any time and must not be able to inadvertently change to or from rescue mode. The RSRL must have a minimum 3:1 mechanical advantage. If the rescuer relinquishes control, the RSRL must stop and hold the load. The RSRL must feature a means to stabilize the device during rescue. Devices that use a power source may be manually operated or powered with speed control and manual back-up. The RSRL must be able to support 3,100 pounds (13.8kN). Finally, the RSRL must raise, lower, and hold the load while holding 125 percent of maximum capacity and 75 percent of minimum capacity.

The new standard also addresses the synthetic rope tackle block. Rope used with the device must be made of virgin synthetic material and must have a breaking strength of no less than 4,500 pounds (29kN). The device must have a static strength of 3,100 pounds (13.8kN). It must also be able to withstand a 2-foot free fall with a 220-pound test weight and continue to function thereafter. It must be able to raise, lower and hold a load. Finally, it must have a minimum mechanical advantage of 3:1.

Descent devices must have a capacity of 310 pounds. Single use devices must have a minimum descent energy rating of 30,000 feet per pound and multiple use devices must have a minimum descent rating of 300,000 feet per pound. Automatic descent control devices must have a descent speed between 1.6 feet per second (5.3m/sec.) and 6.6 feet per second (2.1m/sec.). Additionally, hand-operated devices must not exceed 6.6 feet per second (2.1m/sec.) after the control device is released. Descent devices must have a static load of 2,700 pounds. They must be able to withstand a 2-foot free fall with a 220-pound test weight and continue to function thereafter. Manually-controlled devices must stop if control is released or if a panic grab is applied. Like the synthetic rope tackle block, the rope and webbing used with the descent device must be made of virgin synthetic material and have a breaking strength of no less than 3,000 pounds (13.3kN). Wire rope must be stainless or galvanized steel and have a minimum breaking strength of 3,000 pounds (13.3kN).

Personnel hoists must have a capacity of 310 pounds (140kg) when designed to raise or lower one person and

a capacity of 620 pounds (280kg) for two people. Its capacity must be marked on the hoist. It must be operated by one external power source and must automatically stop and hold the load within 4 inches if control is relinquished. The hoist must raise and lower with a maximum force of 30 pounds (0.13 kN). It must have a static strength of 3,100 pounds (13.8kN). Finally, a hoist with powered operation must have a means to limit applied lifting and lowering force.

Conclusion

It is important to remember that ANSI standards are voluntary, even though they most often reflect the latest technology and fall protection procedures. The laws concerning fall protection still reside with the Occupational Safety and Health Administration (OSHA), the main federal agency charged with the enforcement of safety and health legislation. As the standards are voluntary, implementation will not happen immediately. Exchanging current fall protection equipment for new, ANSI-compliant equipment will take time as will the implementation of managed fall protection programs and other procedures outlined in the new standards. Even so, the Z359 Code will improve industrial fall protection by providing new guidance for fall protection equipment manufacturers, workers at height and their employers.