Session No. 745

What's New in the ANSI Fall Protection Code, Hazard Analysis and Rescue Planning

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Introduction

The Fall Protection code is evolving rapidly as the Z359 Standards writing committee releases new equipment standards every year. Some of the major developments within these standards will be discussed, and the impacts on the end user will be evaluated.

Discussion

The ANSI Z359 Fall Protection Code is a nationally recognized safety standard that came out in 1992.[1] The Z359 Fall Protection Code, Z359.2, covers the manufacturing requirements for fall protection components, but also includes a "user" standard to guide the fall protection community towards safe and proper usage of fall protection equipment. The ANSI Z359 Fall Protection Code is a voluntary standard. You would think that a voluntary standard could be "voluntarily" ignored, but it's not that simple. Because the ANSI Z359 Fall Protection Code is a nationally recognized safety standard that goes into much greater detail than OSHA's 1910 and 1926[2] Fall Protection law, OSHA has written a letter of interpretation that OSHA *will* cite the ANSI Z359 Fall Protection Code as a requirement of Federal Law under the "General Duty Clause," thereby, in effect, making the Z359 code a requirement under Federal Law. It is up to the individual OSHA inspector to reference the ANSI Z359 code as a requirement under the General Duty Clause if he or she chooses.

Let's look deeper into the recent changes in the ANSI code and review how it will affect the typical user of fall protection equipment. Here is a list of some of the recent developments:

- Energy Absorbing Lanyard standard Z359.13- released Nov 2009
- Self-Retracting Lanyard standard Z359.14- New standard has been finalized and is scheduled to be released in November of 2011
- User Code standard Z359.2- released Nov 2007

Energy-Absorbing Lanyard Standard Z359.13

The most obvious changes for Energy Absorbing lanyards (Figure 1) are the labeling requirements. As of its release in 2009, all lanyards must follow a new protocol for labeling.

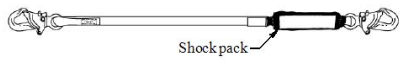

Figure 1. Common Energy Absorbing Lanyard (E.A.L.).

Typical 72” long, energy-absorbing lanyards that are hung from an attachment point at the user’s D-ring or above require the following label:

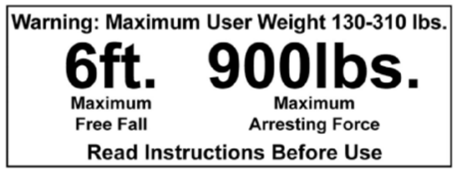

Figure 2. New 6-Foot Free Fall label clearly defines the maximum free fall limit.

Figure 2 denotes that the maximum fall distance the user will experience during a fall will be 6 feet maximum. A typical example of this is a 72” long lanyard attached at the same elevation as the D-ring. For 72” long lanyards that are hung from an attachment point exactly at the user’s D-ring, the user will free fall exactly 6’ before the lanyard starts to restrict (and decelerate) the user’s fall.

If the user uses that same 72” long lanyard, but hangs it at the lowest possible level (at his feet), he will fall significantly farther. Figure 3 shows how the free fall distance will be approximately 12’ before the lanyard reaches full extension and starts to decelerate the fallen worker.

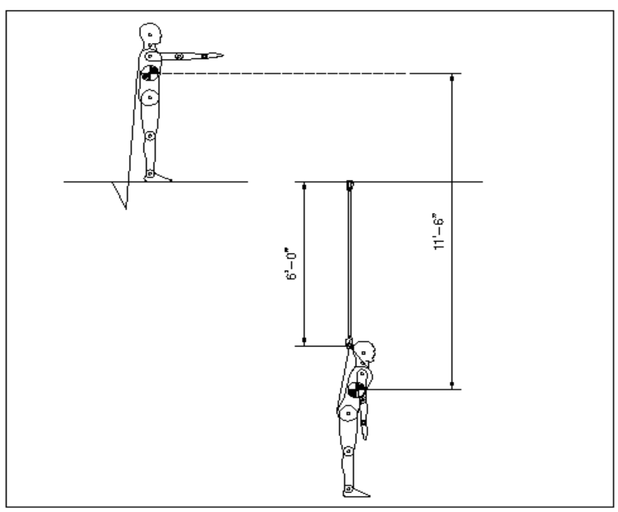

Figure 3. A 72” long lanyard attached at foot level can result in approximately 12 feet of free fall.

If the user plans to attach the lanyard at foot level or at an elevation up to the D-ring elevation, then the 12' Free Fall lanyard (Figure 4) must be used. Figure 5 graphically shows when to use a 6 Foot Free Fall lanyard vs. a 12-Foot Free Fall lanyard.

Figure 4. New 12-Foot Free Fall label clearly defines the maximum free fall limit to be 12 feet.

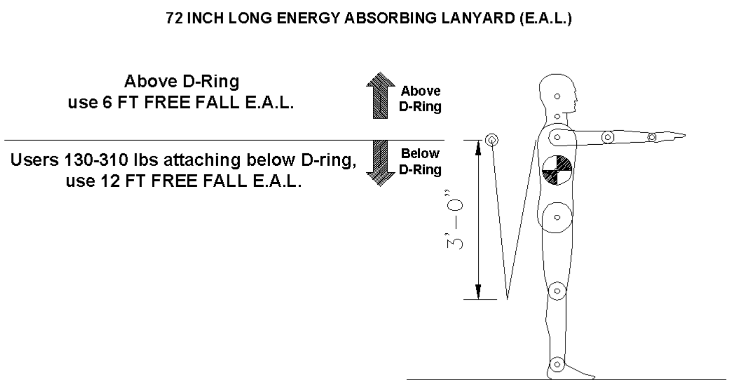

Figure 5. When to use the new "12-Foot Maximum Free Fall" Lanyard.

<u>Self Retracting Lanyard standard Z359.14-</u>

The new ANSI standard for Self Retracting lanyards has been finalized and is scheduled to be released in November of this year. Here are some of the changes that are scheduled to make it into usage for the general fall protection community:

Self Retracting Lanyards will now be referred to, as group, as SRD's or Self Retracting Devices. The name Self Retracting Lanyards still exists for individual devices.

New standards exist for Self Retracting Lanyards with rescue capability. These new SRL's will be referred to as SRL-R's. These SRL's typically have a hoisting mechanism built into the SRL device that allows a worker to access a cranking arm to retract a fallen worker. A coworker must crank a handle to move the fallen worker to safety (Figure 6).

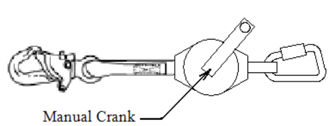

Figure 6. SRL-R Rescue capable--with "Crank to Rescue."

There will also be new standards for Self Retracting Lanyards designed to work specifically at a leading edge of a work platform denoted as SRL-LE's. These SRL's require a much stronger cable or webbing that can withstand the cutting effect of a sharp leading edge without catastrophic failure (Figure 7). Special care must be taken when using lanyards on platforms or structures that have relatively sharp steel edges. Even the ubiquitous wide flange beam commonly used in building construction has an edge sharp enough to sever a 3/16" steel cable when a 220 lb weight is dropped just four (4) feet above the leading edge of the beam flange[3].

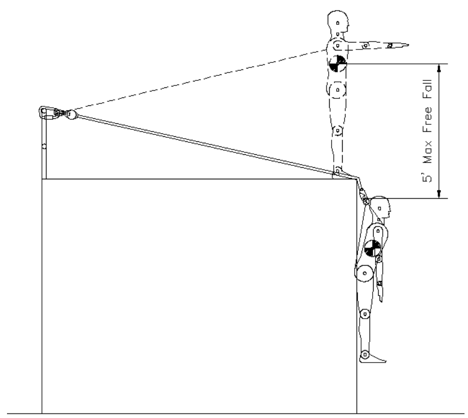

Figure 7. "Leading edge" cutting hazard.

SRL-LE Leading edge lanyards (Figure 8) tend to incorporate a second energy absorber at the snap hook to absorb energy and prevent the main lanyard from being dragged across the sharp leading edge of the work platform. The SRL-LE is engineered for a 5 ft maximum free fall, and pays out a maximum of 54 inches. Figure 9 shows the new dynamic test that all SRL-LE's must pass to conform to proposed Z359.14.

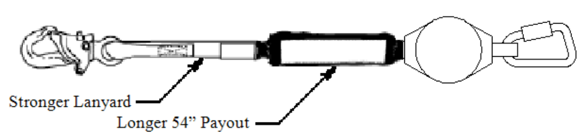

Figure 8. SRL-LE with extra Shock Pack energy and 5-foot maximum free fall.

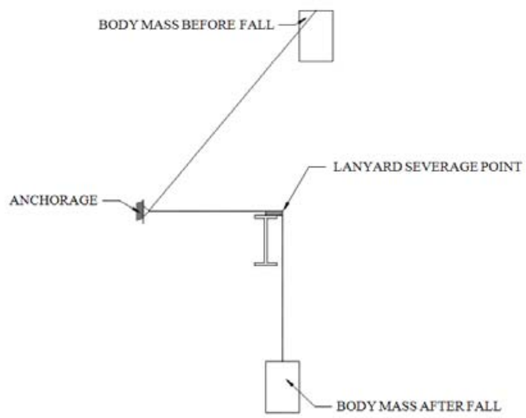

Figure 9. "Leading edge" drop test arrangement.

<u>User Code Standard Z359.2</u>

The "user" standard titled "Minimum Requirements for a Comprehensive Managed Fall Protection Program" was released in 2007. It has been a few years since its formal release, but it's important to review some of the contents because this is the most important standard for people who use fall protection within their organizations.

Every organization that uses fall protection must have a formal "managed Fall Protection Program". Each Fall Protection Program must include a Hazard Analysis and Rescue Plan for every instance of fall protection. The user standard Z359.2 outlines the proper protocols for evaluating each application of fall protection.

A hazard analysis is a written review of each specific location of fall protection. The Competent Person surveys the area and limits of travel where the fall protection will be in use. To assist in the documentation, pictures of the area are normally taken and attached to the written Hazard Analysis. Each hazard the worker may encounter during a fall is then listed and addressed as to how the hazard will be eliminated or mitigated.

Examples of hazards encountered during a fall are:

- Fall distance hazards--18'-6" of clearance must be supplied for 6' long energy absorbing lanyards, and even more for flexible horizontal wire ropes.
- Cutting hazards
- Puncture hazards
- Moving machinery hazards
- Rotation equipment hazards
- Temperature hazards
- Chemical hazards
- Drowning hazards (if fall protection is in use over liquids)
- Sloped surface hazards (a slide down a sloped surface may not be fast enough to engage an SRL)
- Asphyxiation hazards (e.g. grain bins)
- Swing hazards
- Leading Edge hazards
- Suspension trauma hazard

Some hazards not normally reviewed (hazards encountered when there is no fall occurring):

- Overhead cranes- Can overhead facility cranes reach or touch any part of the fall protection system or worker?
- Entrapment hazards- Can loose lanyards or hanging lanyards become hung-up on or entrapped in rotation equipment during normal day to day activities?

Let's look a little deeper into typical fall hazards. The most common fall hazard is fall distance. Fall distance calculations are absolutely critical with energy absorbing lanyards (E.A.L.'s). The commonly accepted clearance required for a 72 inch long E.A.L. is 18'-6" (Figure 10).

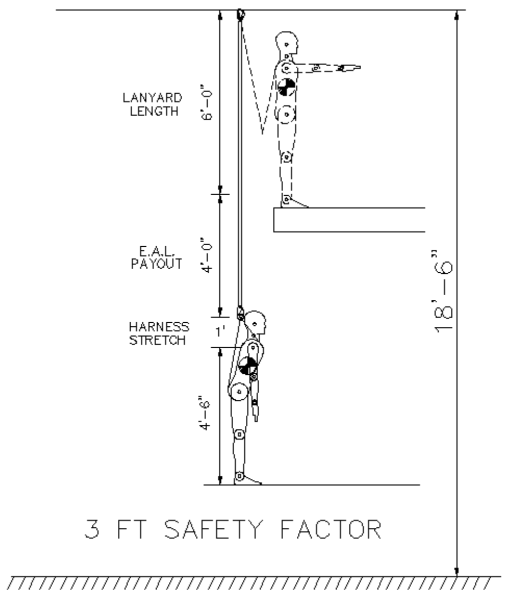

Figure 10. 18'-6" Clearance required for 72" long Energy Absorbing Lanyard.

Flexible horizontal lifelines, which are wire rope systems strung between support columns, are another area where the fall protection professional may significantly underestimate the amount of clearance required. The flexible nature of the horizontal wire rope results in significant downward deflection of the wire rope before the energy absorber engages, and additional downward deflection during the energy absorbing part of the fall. Wire rope deflections of eight (8) feet or more are not uncommon for long spans of wire rope. These wire rope deflections must be added to the energy absorber clearances such as defined in Figure 10. OSHA requires that a Qualified Person perform the engineering calculations for anchorage forces and fall clearance when employing a flexible wire rope system.

Figure 11 shows a good example of an application of fall protection where there are two potentially fatal hazards that have been completely overlooked. Unfortunately these violations occur every day across the United States, and are all too common. The worker in the illustration is tied off to a long flexible wire rope system on the side of a bridge that will deflect too much (fall distance hazard) to resists the impact of the worker onto the road surface. Secondly, there is active traffic (moving machinery hazard) underneath the workers platform that will most likely lead to an impact injury should the worker survive the initial fall.

Figure 11. Worker will impact roadway before fall protection starts deceleration.

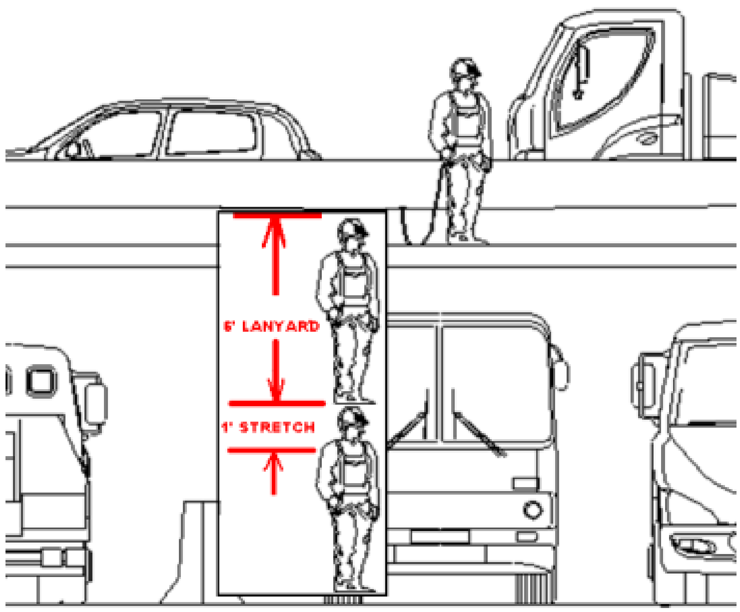

Figure 12. Rough scale of 6' E.A.L. & harness stretch (wire rope deflection not shown).

Swing Falls (also known as pendulum falls) are probably the second most commonly overlooked danger while using fall protection. Yet typical users and members of the fall protection community feel there is no way to avoid a swing fall. The bottom line is, if the attachment point of the user's lanyard is not directly over the user's head, any fall will result in the user's body "swinging" like a pendulum towards the direction of the attachment point. The greater the swing distance is, the greater the chance of injury. In aerospace and aircraft applications, a swing fall may not only result in significant physical injury, but may also result in costly damage to aircraft.

OSHA law limits the maximum off-plumb angle that the lanyard would make during a fall to 30 degrees.

Unfortunately, any off-plumb loading can result in a swing fall into a hazard. Figure 13 shows a typical hangar fall protection system using a long SRL. Unfortunately, this fall will result in an impact of about 40 MPH, with significant injury to man (and plane).

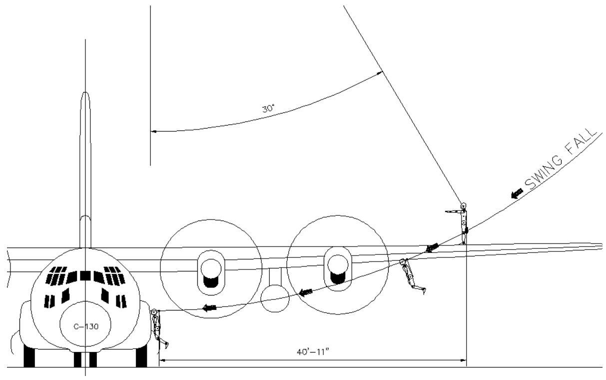

Figure 13. An "OSHA legal" 30 degree swing fall off the back of a C130 wing.

To eliminate the potential for a swing fall, a traveling bridge can be provided to allow the attachment point to remain over the workers head (Figure 14). The traveling bridge arrangement employs rigid tracks that dramatically limit free fall distances and eliminates any potential for swing falls. Additionally, by combining the rigidity of the rigid track system with the fast lockup features of Self Retracting Lanyards (SRL's), the system limits the total free fall distance to a few inches (14"-20") compared to the many feet associated with wire rope/energy absorbing lanyard combinations.

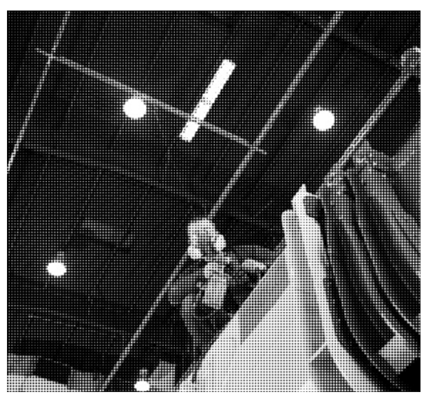

Figure 14. Traveling Bridge with SRL eliminates swing falls, provides shortest fall distance, and minimizes injury.

Finally, Z359.2 outlines what is required to provide rescue to any fallen worker. After a fall the fallen worker may not be able to climb back up to safety. If the worker is left suspended in the fall protection harness, the blood flow path within his/her legs will become restricted due to the leg straps choking off the flow of the femoral artery. This results in blood "pooling" in the legs and not being available to carry oxygen to the brain and other vital organs. The result of this lack of oxygen to the brain is the worker can lose consciousness and pass out. Unfortunately when the worker passes out due to lack of oxygen to the brain, the worker only has a few more minutes to live. The tissue damage or brain damage that occurs due to lack of oxygen is called "suspension trauma" or "harness trauma". OSHA recognizes how potentially fatal a prolonged suspension can be. As a result OSHA requires that prompt rescue be provided for all fallen workers. Furthermore, OSHA has issued a letter of interpretation that

HAZARD ANALYSIS

An onsite evaluation of a task or operation to identify potential hazards and determine necessary controls by breakdown of the task or operation into steps to establish safe work procedures.

Date: ________________ Worksite Description ____________________________

Activity Description, Describing Each Procedure and Result

Identify Hazards

Equipment and/or PPE to be Used

Controls, Inspection Procedures

List of Crew Assigned, Foreman, Competent Person, etc., with Job Duties

Discussion

Approval

Specialized Training or Handouts (Circle answer) Yes No

Responsible Supervisor: ______________________ Date ____________

Competent Person: ______________________ Date ____________

Approved: ______________________ Date ____________

RESCUE PLAN

An onsite evaluation of task or operation to identify potential rescue scenarios and determine necessary controls by breakdown of the task into steps that establish safe rescue procedures. The end result will be a determination of who will perform the rescue and what equipment will be used.

Date: ____________________ Worksite Description ____________________

Activity Description, Describing the fall event occurrence and condition of the person to be rescued-conscious and uninjured, conscious and injured, or unconscious.

Identify obstacles to equipment that must be avoided for proper rescue.

Equipment and additional PPE to be used.

List of Assigned Crew, Foreman, Authorized Rescuer (Z359.0 2.12), Competent person, etc. with rescue duties.

Emergency contact list and phone numbers

Steps/Discussion (Note-A detailed step by step list should be provided separately in a Rescue Procedure)

Approval

Specialized training or handouts (Circle answer) Yes No

Responsible supervisor: ____________________ Date: ______________

Competent person: ____________________ Date: ______________

Approved: ____________________ Date: ______________ Rev C 7/24/09

Figure 15. Sample Hazard Analysis and Rescue Plan

clearly defines the definition of "prompt" as 4 minutes if there is a chance of injury, and 15 minutes if there is no chance of injury.

Per ANSI Z359.2, the competent person within an organization should also perform a rescue plan for every instance of fall protection. Figure 15 shows samples of a written Hazard Analysis and Rescue Plan formats.

A written rescue plan does not guarantee a successful rescue in the event of a fall; the rescue plan must also be practiced. Practicing rescue "drills" is the only way to ensure that the rescue can be provided in a prompt manner.

Organizations with users working at height should practice rescue drills to ensure that aid can be delivered promptly to a fallen worker. If a user falls in a very high location, in the remote regions of your plant, and is rendered unconscious, do you know with certainty you will be able to rescue the worker in four minutes? Rescue plans should be well thought out and practiced regularly to ensure self rescue or the prompt rescue as required by OSHA.

Some issues to address when rescue planning and performing rescue drills are:

- Can self-rescue be provided?
- Has the worker been trained in "self rescue"?
- Can internal employees perform the rescue (coworker rescue)?
- Have the coworkers been selected?
- Is special equipment required to affect a rescue?
- Have the coworkers been trained?

- Has a list of trained rescue workers been compiled with the contact phone numbers?
- Does a professional team need to perform the rescue (fire dept)?
- Has the proper fire department been selected?
- Is special equipment required to affect a rescue?
- Does the use of special equipment require special access or approval in your facility?
- Has the professional rescue team practiced at your facility?
- How often do your training and rescue drills occur? Every year? Every two years?

Conclusion

Selecting and purchasing the proper fall protection equipment for a given application can be a daunting challenge to the supervisor or safety professional. The fall clearance of 18’-6” required for energy absorbing lanyards plus additional clearance required for any wire rope deflections can render the classic wire rope/energy absorbing lanyard as an unacceptable solution. Furthermore, swing falls become an issue any time a worker does not have the attachment point directly overhead. Fortunately, traveling bridge rigid lifeline track systems can be employed to eliminate deflections and swing falls. Traveling bridge rigid lifeline track systems allow the trolley attachment point to remain above the worker at all times. These rigid track systems can be supplied as swing arms, or travelling bridges as shown in Figure 16. Additionally, by combining the rigidity of the rigid track system with the fast lockup features of Self Retracting Lanyards (SRL’s), this limits the total free fall distance to a few inches (14”-20”) compared to the many feet associated with wire rope/energy absorbing lanyard combinations. The less distance traveled during a fall limits the amount of fall hazards and injuries the worker will be subjected to.

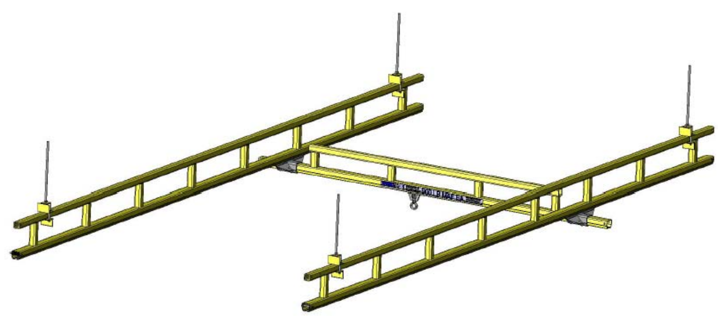

Figure 16. Safest system available today. Rigid Track Traveling Bridge with SRL allows shortest fall distance, eliminates swing falls and minimizes injury.

Finally, new requirements for Hazard Analysis and Rescue Planning and rescue training have placed a higher level of safety preparedness onto the competent person. Documenting hazards and writing rescue plans are not the only requirements for proper rescue planning; the rescue plans must be practiced with rescue drills to ensure the plans will work promptly in the event of an actual fall emergency.

Acknowledgements

The author wishes to thank SPANCO/Rigid Lifelines as well as the many professional colleagues I have worked with over the years in the effort to invent the best fall protection systems that completely minimize fall related injuries.

References

1. ANSI/ASSE Z359 Fall Protection Code, American Society of Safety Engineers.
2. Occupational Safety and Health Act (OSHA) 29 CFR, U.S. Department of Labor.
3. Jürgen Ottersbach, “Fall arrest equipment when used in a horizontal arrangement,” International Fall Protection Symposium 2006, Seattle, WA.