What standards apply to rooftop fall protections systems?

For a number of years, the standards governing the design, installation, use and inspection of fixed fall protection systems have been vague at best. OSHA has taken verbiage directly from the original ANSI fall protection standard that was re ratified in 1999, but has now since been superseded with detailed family of standards.

CFR 29 1915.159(b) (5) “Horizontal lifelines shall be designed, installed, and used under the supervision of a qualified person, and shall only be used as part of a complete personal fall arrest system that maintains a safety factor of at least two.”

CFR 29 1926.502(d) (8) Personal fall arrest systems “Horizontal lifelines shall be designed, installed and used under the supervision of a qualified person, as part of a complete personal fall arrest system which maintains a safety factor of two.”

What does this mean?

Taking the high road, the engineered systems installation community has taken this one paragraph and interpreted it to mean that each system must be independently engineered for the application in mind. All components utilized in the installation must be spelled out by the engineer of record, including the users sub system (such as a harness and lanyard or harness and self retracting lifeline). Each component and the integrated structure must be reviewed by the engineer of record and be found to be able to take on the additional load that may be imposed by this system and still maintain a safety factor of 2 to 1. The qualified person definition provide by OSHA in this case is synonymous with a professional engineer.

The short guide paragraph provided by OSHA has lacked many details and leads to some “creative” interpretation by those who do not want to take the high road. This fuzzy interpretation has prompted ANSI to develop a standard specifically for these types of active fall-protection systems. This new standard has done a lot to square up many of the ambiguities of the brief OSHA standard. While OSHA has not adopted or absorbed this standard, they will look for and site industry specific or accepted standards where they do not have sufficient detail in their own standards. The ANSI standards have been long recognized as a benchmark in the safety industry and are often referenced by OSHA inspectors or investigators.

New developments with the expansion of the ANSI Z359 standard to include .6-2008 “Specifications and design requirements for active fall-protection systems”

ANSI Z359.6 is intended for engineers with expertise in designing fall-protection systems. It specifies requirements for the design and performance of complete active fall-protection systems, including travel-restraint and vertical and horizontal fall arrest.

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systems. The intention is to provide design criteria for routine use and not to provide specific criteria for infrequently encountered problems which occur. This was published 2009.

While it would be a violation of copyright law to reproduce the ANSI document here, a short summary is provided for review:

- Engineering design codes are commonplace for many engineering disciplines.
- With publication of ANSI/ASSE Z359.6-2009 standard, fall protection engineers will now have a fall protection system code of specifications and design requirements.
- The design standard is intended for use by active fall protection system designers; that is, systems which rely upon fall protection to restrain or arrest a fall.
- Passive fall protection systems such as guardrails and nets are not covered by this new standard.
- Work positioning systems are also outside the standard's scope, as are design and performance requirements for manufactured fall arrest components meeting Z359 Fall Protection Code equipment standards.
- This PPT summarizes design standard requirements without detailing specific requirements.
- Z359.6-2009 standard is a resource for engineers involved in custom-engineered fall protection system design, usually intended for a single purpose or location and most often installed permanently for the life of the facility.
- Engineered fall protection systems employers, owners, and end-users may find this to be standard useful in specifying to engineering departments and contractors the standard to be followed in active fall protection system design.
- Each engineered fall protection system must be documented with drawings and specifications prepared by or under an engineer's direction.
- Must provide certain minimum information, including:
  - ✓ a statement defining system type (fall restraint, fall arrest, etc).
  - ✓ a system layout drawing.
  - ✓ a specification of number, location, and qualifications of system workers.

- ✓ system use environmental limitations.
- ✓ System expected performance information.
- ✓ clearance requirements.
- ✓ assembly and installation instructions.
- ✓ minimum anchorage strength.
- ✓ system inspection, maintenance, and repair directions
- ✓ a rescue plan (YES.....a rescue plan)
- ✓ statements that the system must not be modified or relocated except as specified
- ✓ verification of the "as built" system configuration
- ✓ frequency of engineer-recertified anchor structure

❖ When the system is designed by a professional engineer, that engineer must be registered in the state where work is performed;

❖ He/She must stamp and seal each drawing and specification issued.

❖ Fall protection equipment must be constructed of synthetic or metallic materials.

❖ The material ductility (elongation) must be appropriate to the environment where they are used.

❖ Manufactured fall protection components used in the fall protection system must meet applicable sections of ANSI/ASSE Z359 Fall Protection Code.

❖ An active fall protection system designer must specify all equipment and hardware to help ensure compatible connections.

❖ Equipment combinations from different manufacturers are permitted, but must be evaluated by the engineer to verify compatibility.

❖ The engineer exercises some latitude in choosing among various components, so long as he/she are satisfied that no dangerous interactions exist among fall protection equipment.

❖ The engineer is permitted latitude in equipment choice and design approach, but the complete fall protection system must ensure that:

• fall arrest forces are limited to 1,800 lbs. or less.
• adequate clearance is available in the potential fall path.

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• the complete system maintains a safety factor least 2 times maximum anticipated loading.

- For example, the engineer can use a fall restraint system self-retracting lanyard, but SRL line length must not permit the worker to enter a fall hazard zone.

- The engineer can also design a fall arrest system where free-fall exceeds SRL activation distance, but the SRL must be equipped with an integral personal energy absorber to further reduce line loads and to keep fall arrest forces below 1,800 lbs.

- The fall protection system designer must account for several enumerated load requirements, including:

  • dead loads from the system's static weight, and the structure to which it is attached.
  • fall arrest or travel restraint loads applied to the system.
  • live loads due to anchor structure intended use and occupancy.
  • wind, snow, earthquake, or other loads that may be applied to anchor structure.
  • effects resulting from temperature fluctuations, materials creep, or structure settlement.

- The engineer is guided in these decisions by the International Building Code.

  ✓ See International Code Counsel (www.ICCsafe.org)

The design standard provides detailed guidance to the engineer in calculating strength requirements, using formulas approved for factored resistance in fall protection systems, including factored resistance for materials not covered by the ANSI Limit States Design Code. (Steel Structures)

- The design standard additionally provides the engineer with criteria for determining forces on the body, and clearance distances for fall protection systems.
- Free-standing active fall protection systems are considered in the design code.
- The engineer is supplied with load factors for the two primary types of freestanding systems:

  ✓ Counterbalanced System

  ✓ Ballasted Systems
  - those with cantilevered arms that are anchored by counterbalanced masses. These systems must possess a safety factor of at least 4 times the worst case fall arrest system loading and configuration.

- those which rely upon frictional resistance to prevent sliding movement. Ballasted systems must be designed with a safety factor against sliding of not less than 3 times the worst case combination of system loading and configuration. (Freestanding Constant Force Systems)

- This section describes methods to be used by the engineer in calculating forces applied to an active fall protection system to stop or prevent falls. Included in this
section is extensive description of means for determining loads from:
• horizontal lifeline systems, including single and multiple spans.
• multiple worker falls on the same fall arrest system.

- **Next to calculating loads, clearance calculation is the most important evaluation the engineer must perform in fall protection system design. In order to determine minimum clearances, the engineer must accurately calculate the total system fall distance based upon each of the following variables:**

  • **free fall distance** - the unimpeded worker fall distance, which ends when all system slack is removed and further worker displacement is resisted by forces developed in the system.

  • **deceleration distance** - the distance over which the fall arrest system reacts to bring the falling worker to a complete stop.

  • **stretch out** - the stretch of the body support harness, plus worker's body reaction deceleration forces.

  • **swing fall distance** - allowance for additional fall distance created by a pendulum-type fall.

  • **safety margin** - the margin of safety added to allow for unforeseen conditions; the margin of safety is different for rigid and flexible anchor systems

- Assumptions are given which quantify elasticity of wire rope, synthetic ropes, and horizontal lifeline sag.

- The design standard approves both dynamic analysis and energy-balance analysis as tools for evaluating all active fall protection systems.

- Special case examples, such as deployment of a horizontal lifeline energy absorber, are described with approved engineering formulas.

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- The use of test data is discussed and engineers are cautioned to use only test data to interpolate results between known values and to avoid extrapolation of test values beyond the known testing limits.

- The standard includes a list of approved engineering references to publications incorporated in the design standard.

- A substantial non-mandatory appendix is provided with commentary on topics covered in the standard for engineers to better understand the underlying rationale of the requirements.

- A bibliography is also included in the standard for additional reading.

- The standard for Specifications and Design Requirements for Active Fall Protection Systems fills a gap in the uniform application of good engineering practice for fall protection systems.

- While individual product standards have been available for over a decade, there has not been a corresponding code for design complete fall protection system design.

- This standard will prove invaluable for fall protection engineer and is a must for the reference library of every student of fall protection engineering.

Copies of the new standard are available from the American Society of Safety Engineers, Des Plaines, IL, or on-line at www.asse.org.

Building Maintenance Tie Backs

Should the roof anchors be utilized for window washer tie backs or for securing building maintenance equipment such as swing stages or other motorized platforms, the standards shift to that of OSHA 1910.66, ANSI/ASME A120.1-2006 and the IWCA adopted ANSI 1-14.1-2001.

The OSHA 1910.66 standard applies to Powered Platforms, Manlifts, and Vehicle-Mounted Work Platforms for building maintenance. This is the only standard that is available at no charge and can be sourced from OSHAs website.

The ANSI/ASME A120.1-2006 standard applies to Safety Requirements for Powered Platforms and Traveling Ladders and Gantries for Building Maintenance

The ANSI/IWCA 1-14.1-2001 standard applies to Window Cleaning Safety. International Window Cleaning Association (IWCA). Serves as a guide for window cleaners, regulatory agencies, manufacturers, architects, consultants, designers and building owners. Part A focuses on safety guidelines for the use of window cleaning access equipment. Part B is geared toward those who manufacture, distribute, design, install or maintain the equipment

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