

CALCULATING CLEARANCES WHEN USING THE NEW ANSI Z359.13 LANYARDS

Serious injuries can occur if a worker impacts the ground or other lower obstruction. When a fall arrest system is being used, it is essential to know the both the required and the available clearance.

Use of Old ANSI Z359.1 Lanyards

The commonly used 6-foot-long ANSI Z359.1 energy-absorbing lanyard was intended to safely stop a 6-foot free fall of a worker weighing up to 310-lb.

Unfortunately, the 6-foot length lanyard will allow a worker to free fall up to 12-feet if the lanyard is anchored at or below the worker's feet (see Figure 1).

For lanyard systems, knowing the worst-case deployment of the Personal Energy Absorber (PEA) makes clearance calculations very easy. Figure 2 shows how to add up all the factors to understand that the anchor must be at least 17.5 feet above the ground with the old (ANSI Z359.1) equipment.

This method of calculating the “required clearance” is also appropriate for a 12-foot free fall, because the PEA is always assumed to deploy exactly 3.5 feet for ANSI Z359.1 equipment. However, in 12-foot free falls the impact forces that occur after “bottoming-out”

Figure 1. An example of an anchor point located below the worker's feet.



the PEA can exceed the 1,800-lb. limit allowed by OSHA.

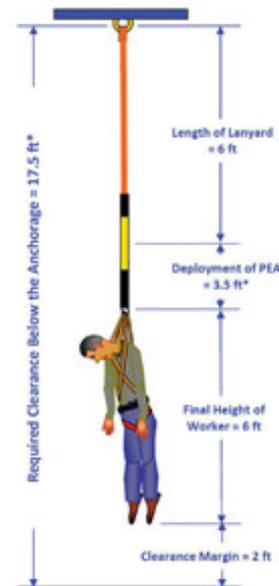
Concerns with using ANSI Z359.1 Lanyards

For workers weighing up to 240 lbs., the ANSI Z359.1 lanyards provide appropriate protection for a 6-foot free fall.

The new Z359.13 lanyards are needed because:

- When using a 6-foot lanyard, unless the anchorage is at or above the worker's shoulders, free falls will exceed 6 feet.
- Even when free falls are less than six feet, experts now recognize that the test mass in ANSI Z359.1 may not properly represent a 310-lb. worker.

Figure 2. Determination of the anchor point for ANSI Z359.1 equipment



The old (Z359.1) requirements were developed several decades ago, based on the commonsense principle that the human body absorbs some of the fall energy. Studies at that time showed for rope lanyards without PEAs that a 1.4 ratio between human and test mass

was appropriate (220-lb. rigid mass representing a 310-lb. worker).

Recent studies have shown that because PEAs reduce the impact force, the energy absorbed by the worker is much less. The newest ANSI Z359 standards use a 282-lb. rigid test mass to represent a 310-lb. worker.

Since the new (Z359.13) PEAs must absorb more fall energy, the standard recognizes that they may need to deploy more than 3.5 feet.

Use of New ANSI Z359.13 Lanyards

In the fall of 2009, ANSI Z359.13, *Personal Energy Absorbers and Energy Absorbing Lanyards*, was released. This standard provides two new classes of PEAs:

- The “6 ft. FF” PEA is intended for a maximum 6-foot free fall and can deploy up to 4 feet.
- The “12 ft. FF” PEA is intended for a maximum 12-foot free fall and can deploy up to 5 feet.

Since the new PEAs deploy further, the “required clearance” might be affected.

Does OSHA allow free falls to exceed 6 feet and PEAs to deploy more than 3.5 feet?

OSHA has not changed free fall and deceleration distance limits. These easily understood objectives provide good guidelines for workers. However, the agency recognizes that in some situations these objectives are difficult to achieve and that exceeding these limits can be safe if two (fundamental) objectives are met:

- the impact force to the worker remains below 1,800 lbs.; and
- the fall stops within the available clearance.

Interpretation letters posted on the OSHA website stipulate that when these objectives

are met, OSHA will accept greater free fall and deceleration distances. The Z359.13 standard was written, in part, to provide equipment that meets the first objective. This fact sheet focuses on how this equipment affects the second objective.

When using the new (Z359.13) equipment, do the required clearances need to increase?

At first glance, if clearance is calculated based on the assumption of full deployment (bottoming-out) of the PEAs, then yes, the clearance distance must increase by 0.5 and 1.5 feet respectively for the “6 ft. FF” and “12 ft. FF” lanyards. (Remember that the new “6 ft. FF” PEA deploys up to four feet, 0.5 feet greater than the old PEA, while the new “12 ft. FF” PEA deploys up to 5 feet, 1.5 feet greater than the old PEA.) However, the clearance increases are not warranted in systems that were properly designed for the old (Z359.1) lanyards, because the maximum deployment for these lanyards is 3.5 feet.

It is rare for PEAs to fully deploy in actual falls unless the worker weights greater than 310 lbs. The new lanyards absorb energy with equal (and often greater) efficiency than the old ones. Thus, the same or less deployment (and clearance) in actual falls with the new equipment generally is expected. **Any scenario that would not bottom-out the old PEAs will NOT deploy the new ones beyond 3.5 feet.**

The only time deployments greater than 3.5 feet may occur with the new (Z359.13) lanyards is for heavy workers and large free falls that would actually bottom-out the old (Z359.1) lanyards. The following options apply in this case:

- Keep using the old (Z359.1) lanyards to maintain present clearance requirements. However, impact forces will spike when this equipment bottoms-out and therefore

should be determined by a “qualified person” to verify compliance with the 1,800-lb. OSHA limit.

- Use the new (Z359.13) lanyards to keep impact force below 1,800 lbs. Doing so will sometimes (but not always) increase clearance requirements due to greater deployment. Clearances should be checked by a qualified person if a worker’s weight exceeds 240 lbs. or free fall exceeds six feet.

Can you continue to purchase ANSI Z359.1 energy-absorbing lanyards?

Yes, for now. The Z359 committee is developing individual standards for each type of fall protection equipment. The committee intends to eventually withdraw ANSI Z359.1.

When may the new PEAs exceed 3.5 feet of deployment?

This will only occur for large free falls of heavier workers. It is possible to provide conservative guidance about when workers’ weight should be factored into clearance calculations.

Using ANSI Z359.6, *Specification and Design Requirements for Active Fall Protection Systems*, a maximum worker weight can be determined for both the “6 ft. FF” and “12 ft.

FF” PEAs that will cause them to deploy exactly 3.5 feet.

To get a universally safe answer, the minimum average deployment force for the new PEAs must be considered. Ultimately, the average force must be at least 705 lbs. for a “6 ft. FF” PEA and 959 lbs. for a “12 ft. FF” PEA to pass ANSI Z359.13. Note that labelling on these devices is mandated to state that the average forces are, respectively, 900 lbs. and 1,350 lbs., but this information is generally NOT reliable since these values represent the maximum force allowed by the standard rather than the actual force. The force shown on the label usually overestimates the ability of these devices to absorb energy. Anyone completing these calculations must use accurate information obtained from the manufacturer or dynamic tests.

To cause PEA deployment of exactly 3.5 feet of the lowest-force PEA that could pass ANSI Z359.13, calculations show the maximum worker weight is 310 lbs. for:

- a 6-foot free fall, using a “6 ft. FF” PEA deploying at 705 lbs.; and
- a 12-foot free fall, using a “12 ft. FF” PEA deploying at 959 lbs.

KEY FACTS

- Correctly developed clearance requirements assuming fully deployed ANSI Z359.1 energy-absorbing lanyards are still valid and safe for ANSI Z359.1 and ANSI Z359.13 PEAs if the worker weighs less than 240 lbs. and the free fall distance is less than 6 ft.
- Greater free falls might not cause more than 3.5 feet of deployment of ANSI Z359.13 equipment, but weight limits should be determined by a “fall protection qualified person” for the actual equipment and free falls involved. A fall protection expert can determine when greater clearances are needed or how much impact can be expected if the PEA “bottoms out.”
- When ANSI Z359.13 PEAs are determined to deploy more than 3.5 feet (needing more clearance than ANSI Z359.1 PEAs), it is critical to use ANSI Z359.13 equipment to prevent impacts.

This fact sheet was developed by the American Industrial Hygiene Association (AIHA) Safety Committee and written by Greg Small, PE, Chief Engineer with High Engineering Corporation (www.highengineering.com).