



ADVANCING FALL PROTECTION WITH FALL SAFE FLEXIBLE LIFELINE OPTIMIZATION (F.L.O.): THE FIRST AND ONLY SRL WITH DUAL-SENSING DETECTION ACTIVATION.

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The Fall Safe brand, under SureWerx, introduces a novel solution to the fall protection industry with the Flexible Lifeline Optimization Self-Retracting Lifeline (F.L.O.). This innovative device addresses longstanding challenges in balancing worker safety and usability in industrial settings. By integrating dual-motion detection technology, which assesses both acceleration and velocity, the F.L.O. enhances lock-up efficiency compared to traditional self-retracting lifelines (SRLs). This article explores how the F.L.O. aligns with updated industry standards, including ANSI Z359.14-2021, and addresses compliance and usability challenges faced by workers in industries such as construction, where frequent transitions between overhead and below-dorsal anchoring are common.

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FALL PROTECTION IN INDUSTRIAL ENVIRONMENTS: LIMITATIONS OF TRADITIONAL SELF-RETRACTING LIFELINES AND THE DEVELOPMENT OF THE FALL SAFE F.L.O. SYSTEM

Fall protection remains a critical safety imperative in industrial settings, particularly within the construction sector, where workers routinely perform tasks at elevated heights. The Occupational Safety and Health Administration (OSHA) establishes clear regulatory thresholds, requiring fall protection for workers at heights of six feet or greater in construction (OSHA 1926) and four feet or greater in general industry (OSHA 1910). Despite these mandates, achieving consistent regulatory compliance while simultaneously maintaining worker productivity and equipment usability continues to present significant challenges. Conventional self-retracting lifelines (SRLs) frequently emphasize safety performance at the expense of usability, resulting in suboptimal compliance rates as workers often bypass equipment perceived as restrictive or cumbersome.

UPDATED ANSI Z359.14-2021

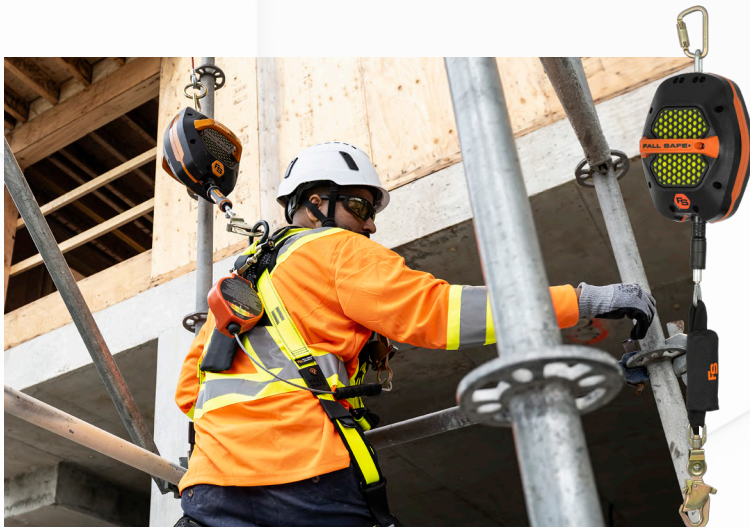
CLASS 1 DEVICES

intended primarily for
overhead anchoring

CLASS 2 DEVICES

designed for
anchoring below
the dorsal D-ring

The updated ANSI Z359.14-2021 standard has introduced more rigorous requirements for SRLs, formally differentiating between Class 1 devices (intended primarily for overhead anchoring) and Class 2 devices (designed for anchoring below the dorsal D-ring). These classifications incorporate enhanced testing protocols aimed at improving overall safety performance and reliability under diverse fall conditions. The present paper analyzes the persistent limitations of existing SRL technologies, the reality of worker safety decision making, and introduces the Fall Safe Flexible Lifeline Optimization (F.L.O.) Self-Retracting Lifeline as a next-generation solution engineered to reconcile safety performance with enhanced usability through targeted technological innovation.



LIMITATIONS OF TRADITIONAL SELF-RETRACTING LIFELINES

Most conventional SRLs depend on single-motion detection mechanisms (typically velocity-based) for lock-up activation. This design approach often leads to operational inefficiencies. Devices may engage prematurely during routine work movements, thereby generating unnecessary lock-ups that frustrate workers and diminish productivity or leads to workers removing their safety devices. Conversely, some units exhibit delayed response times during actual fall events, potentially compromising worker safety.

A further complication arises from the dynamic nature of many work environments, particularly in construction, where personnel frequently transition between overhead and below-dorsal anchoring configurations. Such variability demands versatile equipment capable of satisfying both OSHA 1926 (construction) and OSHA 1910 (general industry) requirements.

Class 1 SRLs, optimized for overhead anchoring, offer restricted tie-off location flexibility and are occasionally misused in below-dorsal applications, elevating fall risk. In contrast, Class 2 SRLs provide greater versatility, including improved performance near sharp edges. However, many Class 2 devices fail to meet OSHA 1910 fall clearance requirements when deployed in overhead configurations. Additionally, a substantial proportion of Class 2 SRLs do not consistently satisfy OSHA 1926's six-foot trigger height threshold and remain susceptible to non-fall-related lock-ups, thereby impeding workflow efficiency and discouraging proper usage.

THE FALL SAFE F.L.O. SELF-RETRACTING LIFELINE

To address these documented limitations, the Fall Safe Flexible Lifeline Optimization (F.L.O.) Self-Retracting Lifeline incorporates dual-motion detection technology. Departing from traditional velocity-only detection systems, the F.L.O. integrates both acceleration and velocity parameters to calibrate lock-up response. This dual-parameter approach seeks to minimize non-fall-related activations during normal work activities while preserving rapid and reliable engagement during genuine fall incidents, thereby optimizing the balance between safety and operational usability.

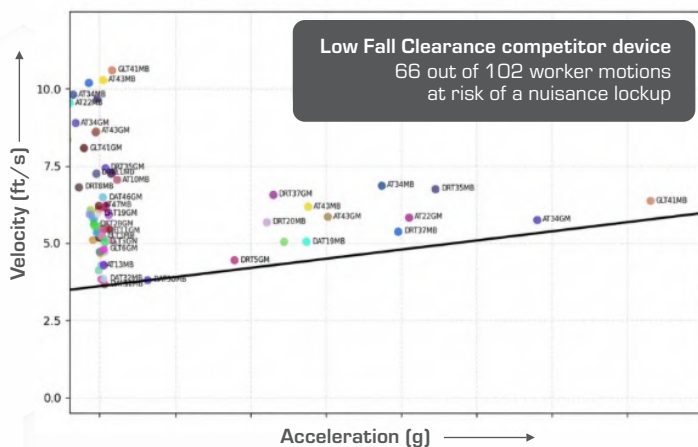


The F.L.O. system is engineered to comply with ANSI Z359.14-2021 specifications for both Class 1 and Class 2 applications, affording workers seamless versatility across overhead and below-dorsal anchoring scenarios. By substantially reducing unnecessary lock-ups, the design mitigates user frustration and promotes consistent adoption, supporting improved compliance with relevant OSHA standards. Furthermore, the system's architecture specifically addresses fall clearance constraints, ensuring compatibility with both OSHA 1910 and OSHA 1926 trigger height requirements across varied industrial contexts.

DEVELOPMENT OF THE FIRST AND ONLY DUAL MOTION SRL ACTIVATION SYSTEM

Fall Safe worked with a leading design engineering firm, Holmes Solutions, to create a locking mechanism that detects falls quickly, while letting workers move more without those nuisance lock-ups under normal worker movements. The dual motion detection has two axis: one axis is set up to detection on velocity, and another axis is designed to detect on acceleration. Other SRLs on the market detect on a single motion or from a mechanical design perspective, have locking pawls that pivot on a single axis. These SRLs have a constant lock-up line when measured on a velocity and acceleration graph. Manufacturers can “tune” the single motion detection to have a lower fall clearance, but they then trade-off worker usability. Reversely, they can “tune” the SRL to lock-up on a higher velocity, thus increasing usability, but they then trade off fall clearance safety. These velocity based locking mechanism must reach a certain speed before locking.

Comparison SRL Expected Motion Lockups

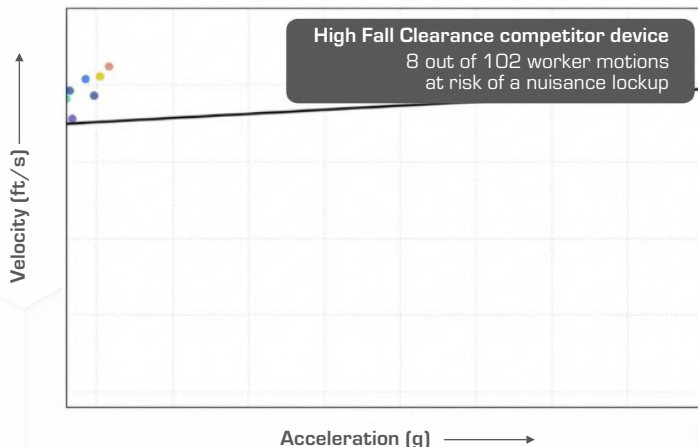


Many lockups at low acceleration typical of worker motions.

POOR USABILITY.

Lockups at high acceleration (1g) motions, ensures safety for potential fall events. **GOOD FALL CLEARANCE.**

Comparison SRL Expected Motion Lockups

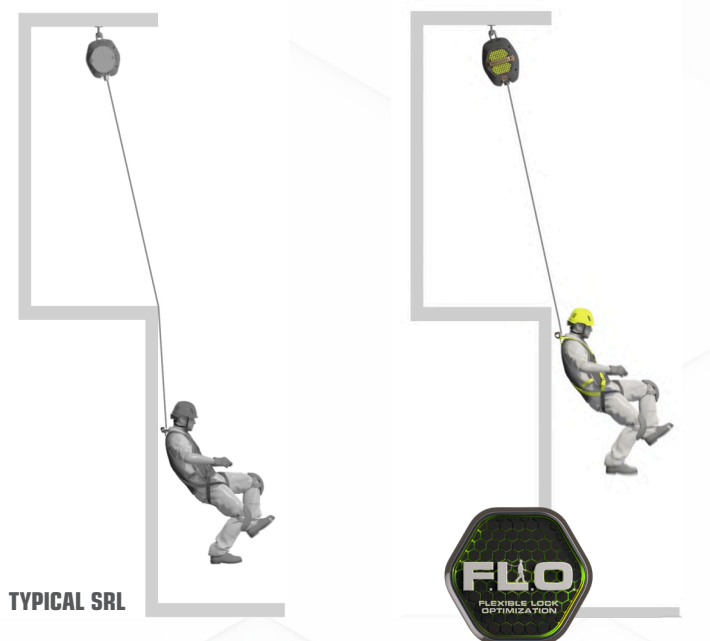


Some lockups at low acceleration typical of worker motions.

GOOD USABILITY.

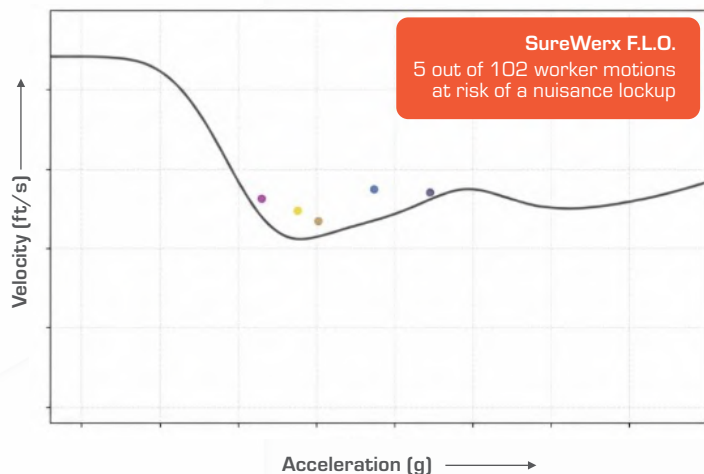
No lockups at high acceleration (1g) motions, compromised safety due to **LARGE FALL CLEARANCE REQUIRED.**

In Partnership with Holmes Solutions, Fall Safe started development by quantifying the problem. Using motion capture cameras and motions balls connected to the dorsal D-ring, we measured the velocity and acceleration of over 100 different worker motions. We started by measuring the velocity and acceleration of an untethered worker to quantify a desired state. Examples included walking at normal speed for 20 feet and then stopping and bending over to pick up an object. And walking at normal speed and then stepping over a wide opening, simulating a concrete form on the floor a worker may need to step over. Next, we put SRLs on workers and went through the same motions. This time we also measured the acceleration and velocity of the anchored SRL, as the moving SRL during usage has an impact on lock-ups. We measured the market leaders and we also measured the velocity and acceleration of a fall from different vantage points. We were able to use this information to separate lock-ups during normal worker motions from lock-ups in a fall on a velocity and acceleration curve. The dual motion detection uses pawls with two axis points, so that it can detect and lock during a slow velocity/fast acceleration (a fall) and not lock during slow acceleration/brisk velocity.



The outcome of this development is the first and only SRL with dual motion detection and meets ANSI Z359.14-2021 Class 2 SRL The Fall Safe F.L.O. SRL has >30% less nuisance lock-ups than the closest competitor. Without trading off safety, the same unit boasts 4' Overhead Fall Clearance, which is >30% better fall clearance than closest competitor. This allows safety managers to put a single safety solution on site that provides compliance across more situations and a product that workers enjoy using more.

SureWerx SRL Expected Motion Lockups



No lockups at low acceleration typical of worker motions.

CLASS LEADING USABILITY.

Some lockups at high acceleration (1g) motions, ensures safety for potential fall events and **CLASS LEADING FALL CLEARANCE.**

The introduction of the F.L.O. marks a major advancement in fall protection technology. Recognizing that product usability directly influences safety, Fall Safe set out to address the trade-offs between protection and ease of use. Its dual-motion detection system establishes a new standard for SRL performance by reducing the inefficiencies common in traditional devices. In addition, compliance with ANSI Z359.14-2021 confirms that the F.L.O. meets rigorous safety requirements while providing the flexibility needed for dynamic work environments.



The implications of this innovation are especially relevant for industries like construction, where workers frequently encounter complex anchoring scenarios. By combining Class 1 and Class 2 performance in a single device, the F.L.O. eliminates the need for multiple SRLs, simplifying equipment management and reducing costs. Its user-friendly design also encourages proper and consistent use, helping to address one of the biggest challenges in fall protection.

The Fall Safe F.L.O. Self-Retracting Lifeline represents a significant advancement in fall protection. Its dual-motion detection technology and compliance with ANSI Z359.14-2021 standards deliver reliable performance across a wide range of applications. By minimizing nuisance lock-ups while maintaining protection in diverse anchoring situations, the F.L.O. helps workers move more freely and work more efficiently.



For safety managers, it's one solution that simplifies equipment selection and standardization across the jobsite. For workers, it's fall protection without the trade-offs.

Future research will evaluate the F.L.O. system through field deployment studies to quantify its impact on compliance rates, worker acceptance, and overall safety outcomes relative to legacy SRL technologies. Both OSHA 1910 and OSHA 1926 trigger height requirements across varied industrial contexts.



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