# Horizontal Lifelines in Bridge Construction, Inspection, and Maintenance

American Road & Transportation Builders Association

Temporary or permanent horizontal lifelines provide workers with the flexibility to move safely on bridges and/or scaffold structures for inspection, maintenance, and construction activities. But preventing falls through the use of horizontal lifelines requires planning, properly engineered systems, proper fall protection equipment, and hands-on training.

## Horizontal Lifeline (HLL) Concepts

Temporary and permanent horizontal lifeline systems require user equipment such as a full body harness, a shock-absorbing lanyard, or an anti-ratcheting self-retracting lifeline, to ensure 100% fall protection at all times. The equipment must comply with the Occupational Safety and Health Administration (OSHA) arresting force limitations of 1,800 pounds or less [29CFR1926.502(d)(16)(ii)]. It should be easy to use and comfortable to wear. There are four basic steps to keep in mind when choosing fall protection equipment:

- **Have a qualified person assess the fall hazard:** What kind of work is the crew doing and where are the fall hazards located? Different stages of the bridge inspection, maintenance, and construction may require different forms of fall protection.
- **Plan for falls:** What will happen in the case of a fall? Think about the structures below the crew and their fall clearance. Ensure workers will not strike structures below. Plan for prompt rescue. Both unassisted and assisted rescue measures must be provided [29CFR1926.502(d)(20)]. In addition, employers must be prepared to provide emergency first aid to a fall victim within 3-4 minutes [29 CFR 1926.50(c) and OSHA Letter of Interpretation dated January 16, 2007 to Pro Med Training Center].
- **Select the appropriate equipment for the job:** Think about the level of comfort and mobility needed from the equipment and the work location. Ensure the full body harness is sized properly. The harness must be snug fitting to the body and legs. Ensure the harness is not too tight and the worker has full range of movement. If it is too loose, a worker's shoulders can come out of the harness in the event of a head first fall. In the event of a fall, if the leg straps are too loose, significant and permanent injuries may happen to worker's scrotum and testicles.

*Source: www.engineeredfallprotection.com*

- **Properly train workers, supervisors, and competent persons:** When using safety products, even the smallest things make a very big difference. Competent persons and workers must be trained in the most effective and quickest ways to make adjustments to fall protection systems. Competent persons and workers must be able to recognize and avoid potential problems [29CFR1926.503(a)(1)]. The competent person has the authority to s**top work until hazards are corrected [29CFR1926.32(f)]. The best employer safety programs always allow all employees to call for timeout to evaluate potentially unsafe and unhealthy conditions.**

## Installation of Horizontal Lifeline Systems

Horizontal lifeline systems can be job-built or they can be pre-engineered/commercially available systems with built-in shock absorbers. The shock absorber provides catenary* in the line in order to safely take the arresting forces applied by the worker's fall. The sag in the horizontal lifeline reduces the forces applied to the horizontal lifeline and the connection points.

A job-built horizontal lifeline can also be used if properly engineered with the proper size of wire rope and attached to two substantial anchorage points on the job site with enough catenary in the line to ensure an engineered safety factor of two [29CFR1926.502(d)(8)].

Regardless of the horizontal lifeline system, the systems shall be designed, installed, and used under the supervision of a qualified person as defined by OSHA [29CFR1926.32(m)]. ANSI/ASSE Z359.2 Section 5.4 states horizontal lifelines sustain two times the maximum tension in the horizontal line during the fall arrest in the direction applied by lifeline forces.

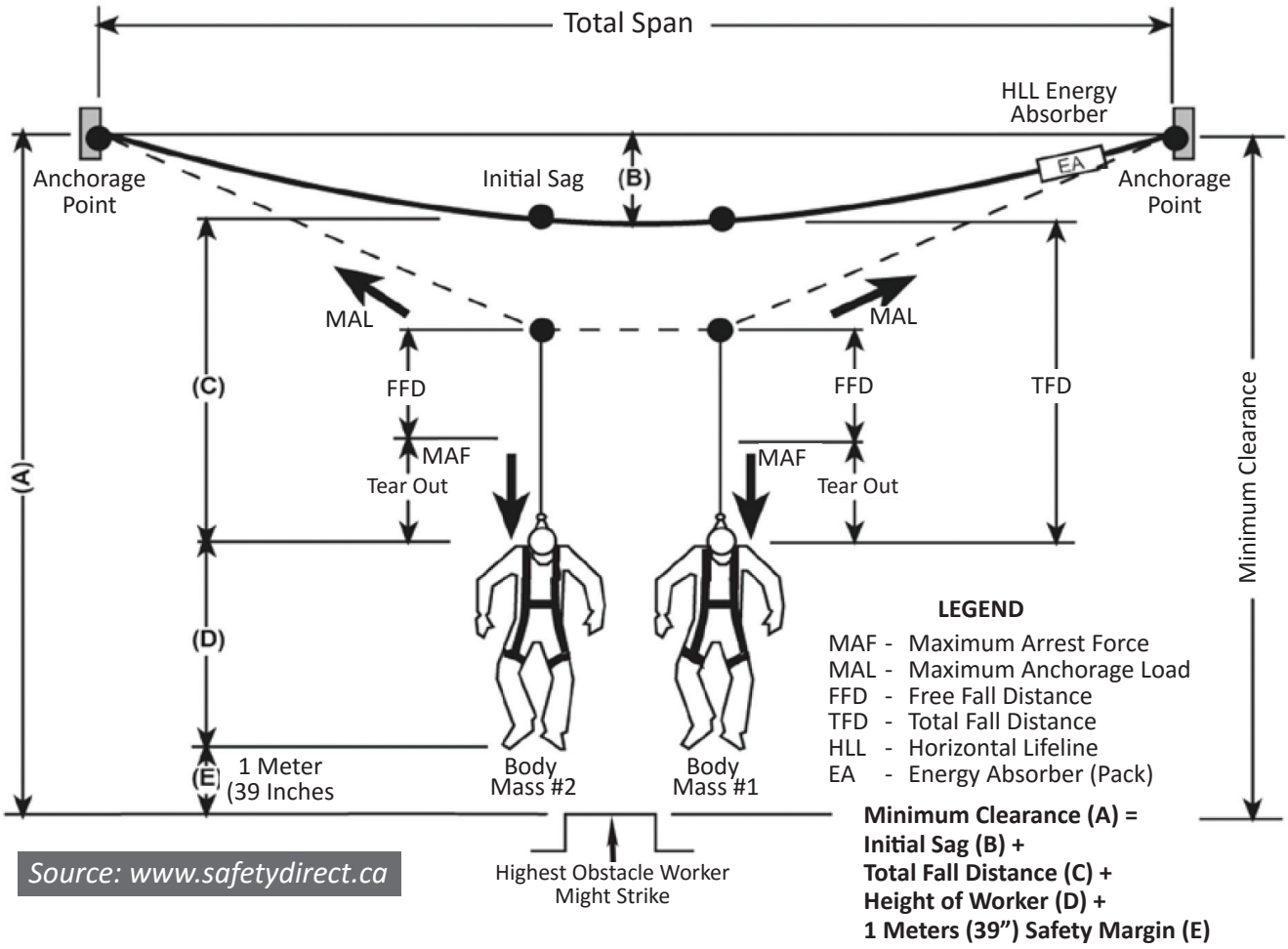
*NOTE: Catenary means that the line has sag, resulting in the line being limp, not tight between the two connection/anchorage points; in engineering terms, a parabolic curve.

## Horizontal Lifeline Systems (continued)

Below is a diagram for a typical pre-engineered/commercially available system with built-in shock absorbers. As discussed, the sag in the horizontal lifeline reduces the forces applied to the horizontal lifeline and the connection points. This sag, while essential for the operation of the horizontal lifeline system, introduces two factors that must be accounted for in installation and use.

- **Sag increases the fall distance.** The natural sag in a horizontal lifeline (B) increases with the length of system. A 20-foot system may sag only 1 inch or so, but a 100-foot system can have as much as 1 foot of natural sag at its center point. Combined with sag caused by loading in a fall, the total fall distance may vary from 18 feet to 40 feet.

- **Sag impacts the location of the worker after a fall.** Because of the sag, workers who fall on a horizontal lifeline tend to migrate to the center point of the lifeline. This poses two challenges to assure that the worker will not smash into an obstruction while migrating to the low point in the line after a fall and to assure that rescue is possible at all points along the horizontal lifeline.




*Source: www.safetydirect.ca*

This fact sheet offers only the briefest introduction to horizontal lifeline systems. Its main purpose is to highlight some of the technical issues involved and to motivate you to look carefully and use qualified persons when setting up such a system.


***ARTBA Work Zone Safety Consortium***

- American Road and Transportation Builders Association
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- International Union of Operating Engineers
- Community College Consortium For Health and Safety Training
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