STEEL ERECTORS SAFETY ASSOCIATION OF COLORADO

# Fall Arrest System Drop Testing Report

## 6’ Elevated Horizontal Life Line
## Anchored to Structural Steel

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# 1. Introduction

## 1.1. Objective:

The objective is to proof test all the components involved in the horizontal life line system. This testing was done in accordance with the performance standards set forth in the Occupational Safety and Health Administration standard 1926.502 and under the guidance of the Safety Standards for Fall Protection in the Construction Industry Preamble.

## 1.2. Definitions:

For the purposes of this report, the following definitions apply:

**Anchorage**
The terminating component of a fall protection system that is intended to support any forces applied to the system.
**Deceleration Distance**
The vertical distance between the user's fall arrest attachment at the onset of fall arrest forces during a fall, and after the fall arrest attachment comes to a complete stop.
**Energy Absorbing Lanyard**
The type of equipment tested. A component of a fall arrest system, the main purpose of which is to absorb fall energy as it limits fall distances. Each energy absorbing lanyard has a catalog record of 6 ft in length.
**Fall Arrest System**
The collection of equipment components that are configured to arrest a free fall.
**Free Fall**
The act of falling before a fall protection system begins to apply forces to arrest the fall.
**Free Fall Distance**
The amount of distance fallen by simulaid before any deployment of the energy absorbing lanyard.
**Hanging Load**
Load as measured by the load cell and data collection system when the simulaid was hanging on the HLL after the fall.
**Harness, Full Body**
A body support designed to contain the torso and distribute the fall arrest forces over at least the upper thighs, pelvis, chest and shoulders.
**Horizontal Lifeline(HLL).**
A component of a horizontal lifeline subsystem, consisting of a flexible line with connectors or other coupling means at both ends for securing it horizontally between two anchorages or anchorage connectors.
**Lanyard**
A component consisting of a flexible rope, wire rope, or strap, which typically has a connector at each end for connecting to the body support and to a fall arrester, energy absorber, anchorage connector, or anchorage.
**Peak Load**
Maximum load measured by the load cell and the data collection system.
**Self-Retracting Lanyard (SRL)**
A device containing a drum wound line that automatically locks at the onset of a fall to arrest the user, but that automatically pays out from and retracts onto the drum during normal movement of the person to whom the line is attached. After onset of a fall, the device automatically locks the drum and arrests the fall.
**Simulaid**
Simulaids are manikins that represent an actual human, they are the best way to maintain the reality of a fall without using a live subject. The head and body are built of dense, flexible, life-like vinyl.
**Swing Fall.**
A pendulum like motion that occurs during and/or after a vertical fall. A swing fall results when an authorized person begins a fall from a position that is located horizontally away from a fixed anchorage.
**Total Fall Distance**
The total amount of distance fallen by the simulaid including deployment of energy absorbing lanyard, harness stretch, and HLL sag.
**Vertical Lifeline.**
A component, element or constituent of a lifeline subsystem consisting of a vertically suspended flexible line and along which a fall arrester travels.

## 1.3. Components:

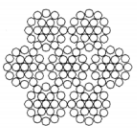
- Type 1 six foot adjustable length shock absorbing web lanyard w/pack, #74N locking snaps at each end.42” deceleration.

- One 8-foot retractable web lanyard with swivel top and carabiner, 3600 lb. gate hook

- One 6’ long vinyl-coated galvanized cable choker anchor

- Four 3/8” galvanized drop forged cable clips

- 3/8” 7 x 19 Galvanized Aircraft Cable



Specification Requirements:
Performance Standard & Dimensions:
Federal Specification MIL-DTL-83420M
Type: I
Composition: A
Construction: 7 x 19
Material: Drawn galvanized high carbon steel per Federal Specification MIL-DTL-83420M
Minimum Breaking Strength: 14,400 lbs

| Part Numbers | Nominal (inch) | Working Load Limit (lbs) | Minimum Breaking Strength (lbs) |
|---|---|---|---|
| 0545502 | 3/32 | 200 | 1,000 |
| 0545503 | 1/8 | 400 | 2,000 |
| 0545504 | 5/32 | 560 | 2,800 |
| 0545505 | 3/16 | 840 | 4,200 |
| 0545506 | 1/4 | 1400 | 7,000 |
| 0545507 | 5/16 | 1960 | 9,800 |
| 0545508 | 3/8 | 2880 | 14,400 |

### 1.4. Recording Apparatus:

1. One Dillon ED Xtreme 5000 LB capacity dynamometers


2. One Dillon Communicator


3. One Surface Pro 4

### 1.5. Testing Conditions:

Ambient Temperature= 91 Degrees Fahrenheit
Wind= SE 11.185 MPH
Condition= Scattered clouds
Humidity = 22 %
Barometer= 29.97 hg

### 1.6. Testing method:

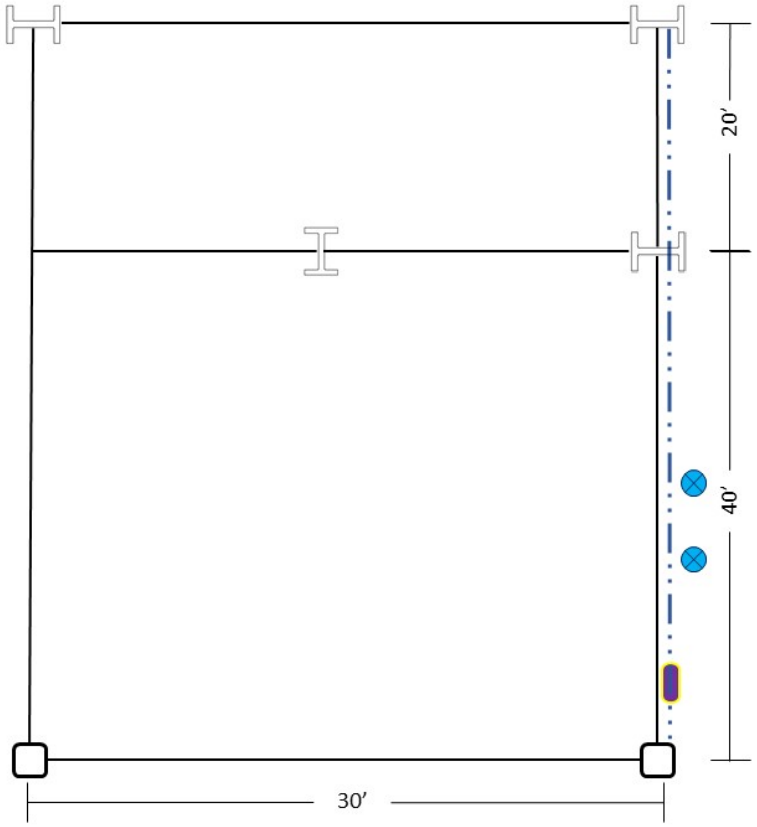
Two 225 lbs. test simulaids were dropped semi-simultaneously on a 3/8" aircraft cable Horizontal Life Line (HLL) that was anchored by structural steel. At one end the 3/8" aircraft cable was threaded through holes pre punched in the column. At the intermediate point the cable was threaded through holes pre punched in the column. At the adjacent end point the cable was attached to a dynamometer that was attached to the eye of one 6' long vinyl-coated galvanized cable choker anchor that was double wrapped around the HSS column. The cable was secured at each end using two drop forged cable clips. One simulaid was attached (tied off) to the HLL using a 6' adjustable shock absorbing lanyard, the other with an 8-foot retractable web lanyard. The determination to use two 225 lb. test simulaids with a 1.4 multiplier was based on the widely accepted practice that the multiplier compensates for the damping effect, or absorption, of a falling workers body, and ensures the equipment is tested to maximum capacity.
The formula used is as follows:

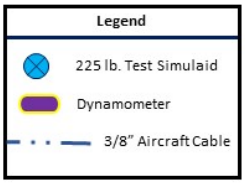
225 lb Rigid Simulaid x 1.4 (force absorbed by dynamic human body) = 315 lb. Fully clothed / tooled worker.

The second simulaid was dropped semi simultaneously to recreate a worst case scenario that might be experienced in a real life situation if two workers were attached to the same HLL.

### 1.7. Anchorage Configuration:

### 1.8. Testing configuration:




MSC Safety Solutions Testing Plan

3/8" aircraft cable horizontal life line suspended by structural steel

# 2.Test Observations:

## 2.1. Fall Metrics

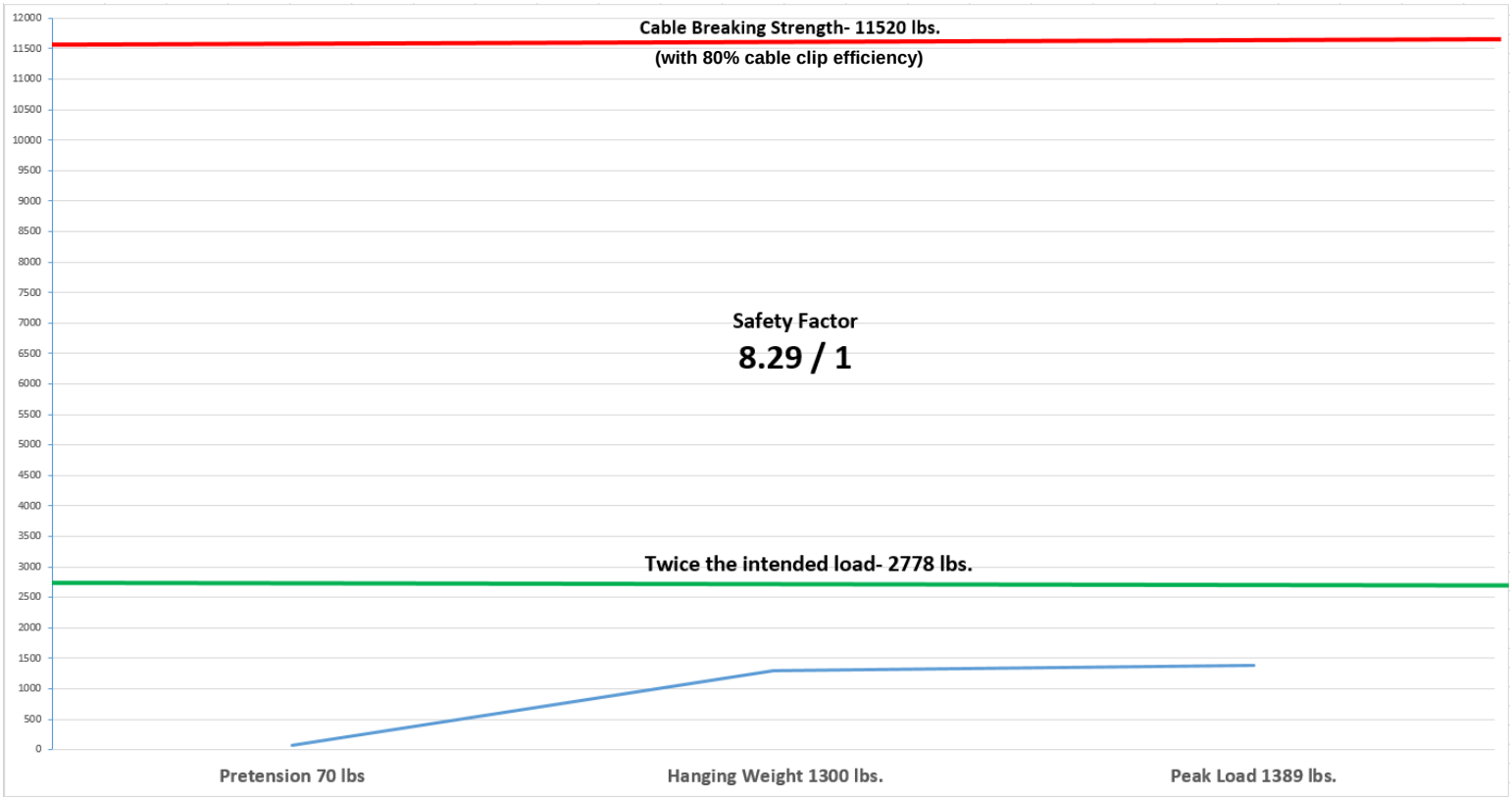
**6’ Foot Adjustable Length Shock Absorbing Web Lanyard**

| Lanyard Length Pre Test | Lanyard Length Post Test | Total Fall Distance | Free Fall Distance | Deceleration Distance | Damage /distortion to anchorage | Damage /distortion to cable | Initial Sag in HLL | HLL Sag Post fall |
|---|---|---|---|---|---|---|---|---|
| **6’ 1”** | **9’ 11”** | **11’ 8 1/2”** | **7’ 10 1/2”** | **3’ 10”** | **None** | **Minor bending** | **1’ 2 ½”** | **2’ 6”** |

**8-foot retractable web lanyard with swivel top**

| Lanyard Length Pre Test | Lanyard Length Post Test | Total Fall Distance | Free Fall Distance | Deceleration Distance | Damage /distortion to anchorage | Damage /distortion to cable | Initial Sag in HLL | HLL Sag Post fall |
|---|---|---|---|---|---|---|---|---|
| **3’** | **5’ 5”** | **7’ 2”** | **4’ 9”** | **2’ 5”** | **None** | **Minor bending** | **1’ 2 ½”** | **2’ 6”** |

## 2.2. Loading Metrics



# 3.Conclusions:

The results and recommendations presented from this successful drop (proof) test on a 3/8” aircraft cable horizontal life line anchored to structural steel, provided invaluable data for the actual loading and total fall distance that can be expected when using this system. All safety system components were examined after the tests and there was no major physical damage or failure other than minor bends in the cables at the anchorage locations where it was supported by the structural steel. The drop tests performed, and the data shown above, provides documentation for proof tests of the safety systems in question. There are a couple of items to note which make these results conservative too real-life conditions. First, the simulaids do not have the elasticity that a human body can achieve during a fall. This elastic state that a human body exerts during a fall will absorb some of the energy from the safety system. The result would be a slightly lower maximum tension value than what is shown above. Second, our history shows that it is extremely unlikely that two men will fall on the same HLL. However, to be conservative we dropped both simulaids within the same span and the results were accounted for in the above data.

It is reasonable to assume the following:

1. A worker “tied off” using an 8' retractable lanyard, attached to 3/8” horizontal life line cable, installed at 6’ above the walking/working surface, would not contact the next lower walking/working surface of => 7’ 3”.
2. A worker “tied off” using a 6’ adjustable length shock absorbing web lanyard, attached to 3/8” horizontal life line cable, installed at 6’ above the walking/working surface would not contact the next lower walking/working surface of => 11’ 9 1/2”.

3. In both scenarios, if the HLL was installed higher the total fall distance will be reduced by the amount raised above the 6’ mark from the walking /working surface, thus reducing the total fall distance.

4. Conversely, if the line was installed lower, the total fall distance will be increased by the distance the cable was installed below the 6’ mark from the walking /working surface.

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The information contained within this report is for informational purposes only. Fall arrest systems must be installed, evaluated and used only by a competent person.

# 4.Photographic Evidence: