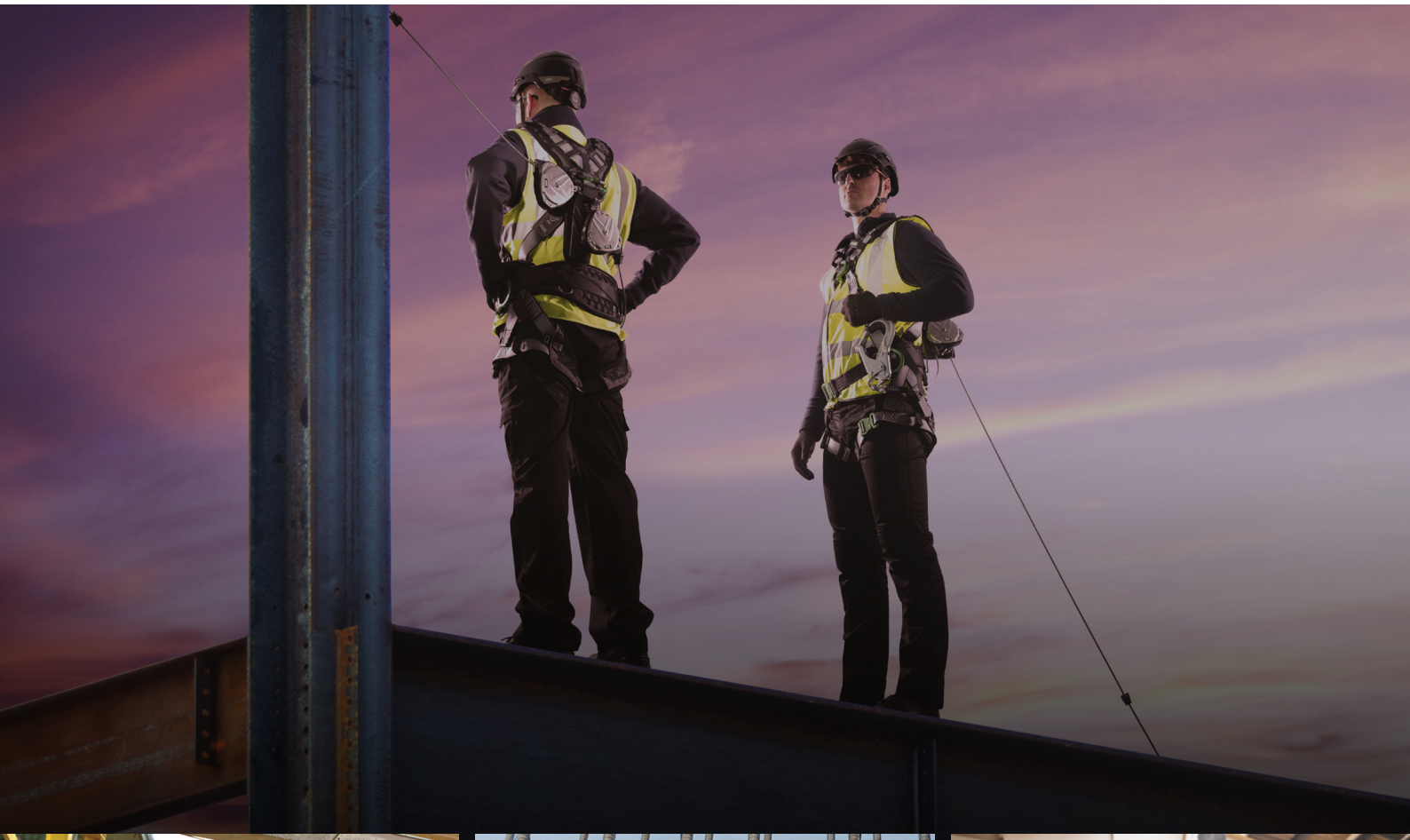
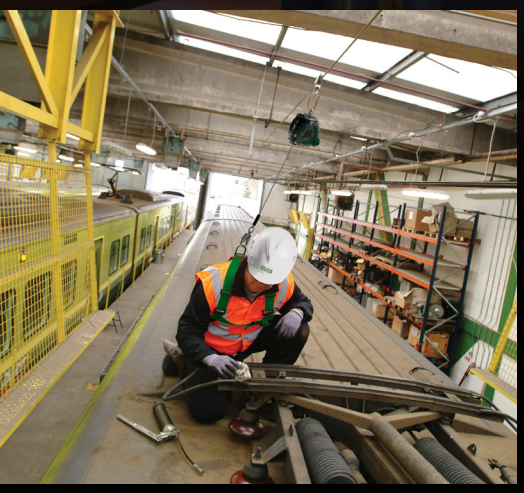
MSA
The Safety Company

Establishing safe fall clearances for working at height

An MSA White Paper





WE KNOW WHAT'S AT STAKE.

Each year an estimated 646,000 individuals die from falls globally, and falls remain the second leading cause of accidental or unintentional injury deaths,[1] which is why understanding fall protection and and how to calculate fall protection clearance is so important.

Failing to correctly calculate an adequate fall clearance distance beneath operatives working on a platform at height is one of the most common and potentially dangerous oversights when conducting a risk assessment.

This whitepaper highlights the key fall clearance risk factors to consider when planning work at height. It will show how to establish the minimum safe fall protection clearances based on the type and location of an attachment anchor, the working platform height, obstructions below and the length and performance characteristics of a given lanyard, Personal Fall Limiter (PFL) or Self-Retracting Lifeline (SRL). It will also discuss the importance of related training and equipment inspection and maintenance regimes.

What is fall clearance?

You have just received your new full body harness, 2m shock-absorbing lanyard and anchorage connector, and your structural engineer has qualified all of your anchor points to ensure that they meet strength requirements, as per EN 795 or OSHA regulations. At this point, however, it's important to remember that your fall arrest system may well not be complete.

If you have not determined available clearance below the working surface and calculated your total fall distance properly, a fall event may still be possible, leading to potential serious or fatal injury.

A safe fall clearance exists to help ensure that any fall from a working platform or leading-edge application will be arrested before a worker can impact the ground or any other obstruction, such as machinery or piping.

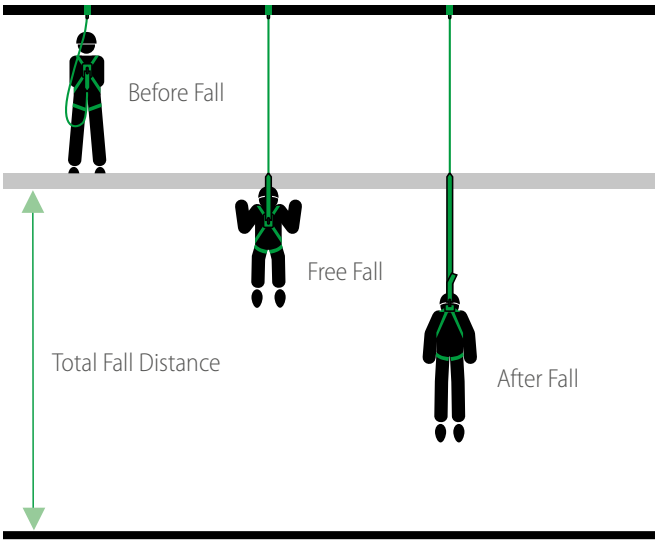
Calculating distances for lanyards

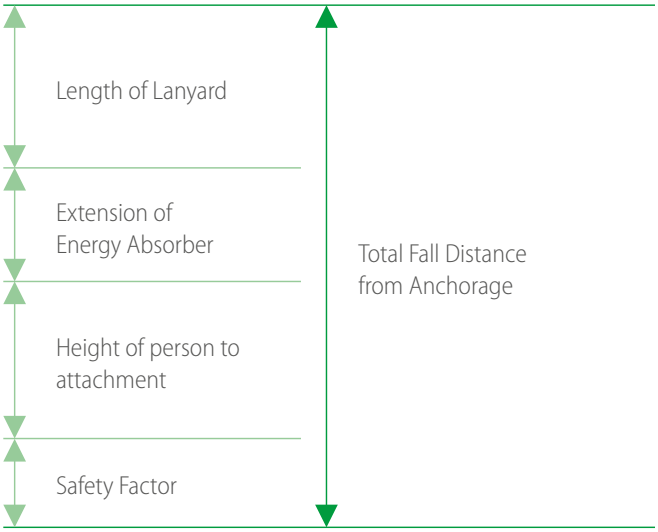
In a fall, the maximum deployment (stretch, open, tear) length of the lanyard is 1.75m, as per EN355. Allowing 2m for the length of the lanyard, another 2m for the height of a worker, and a further 1m safety margin to the ground or any obstruction, the total fall distance from anchorage is 6.75m.

It is critical that the total fall distance is calculated from the platform as this number will change based on the location of the anchorage, which can be overhead, at torso-level, or at foot-level (for leading edge works, for example). As a rule of thumb, the total fall distance from the working platform can be calculated by subtracting the height of the anchor point above the working platform from the total fall distance from anchorage.

The following diagrams illustrate how each different anchor height configuration has a significant impact on the total fall clearance required. For indicative purposes, the following equipment is used:

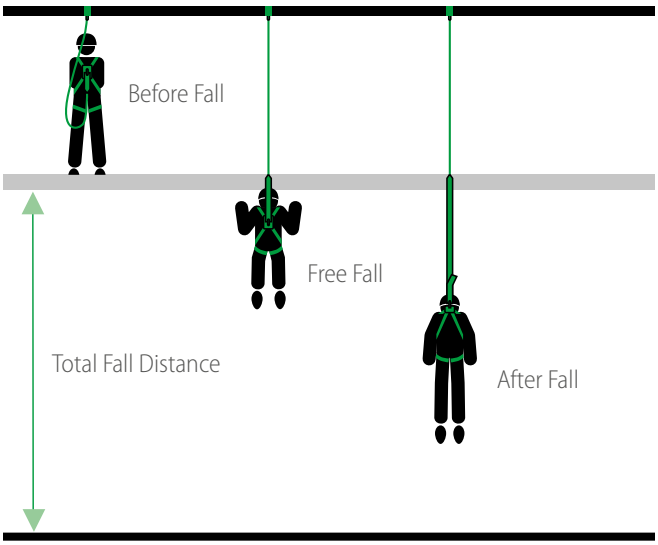
- 2m shock-absorbing lanyard
- Full body harness
- Fixed, rigid anchorage connector (such as a D-plate bolted to a structural I-beam)

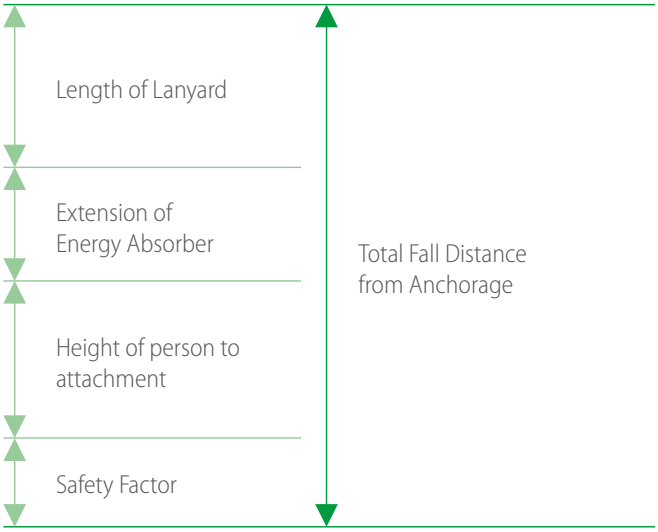




1. World Health Organization, Falls

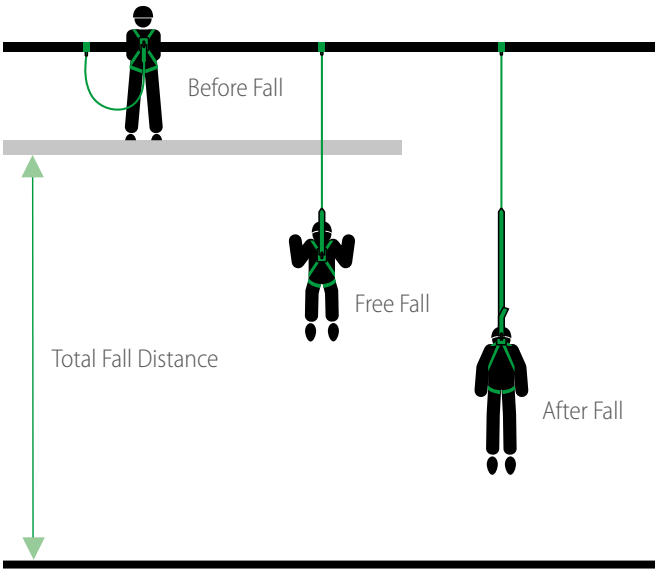
1. Overhead tie off at **2m above** the working platform (one of the best-case scenarios)

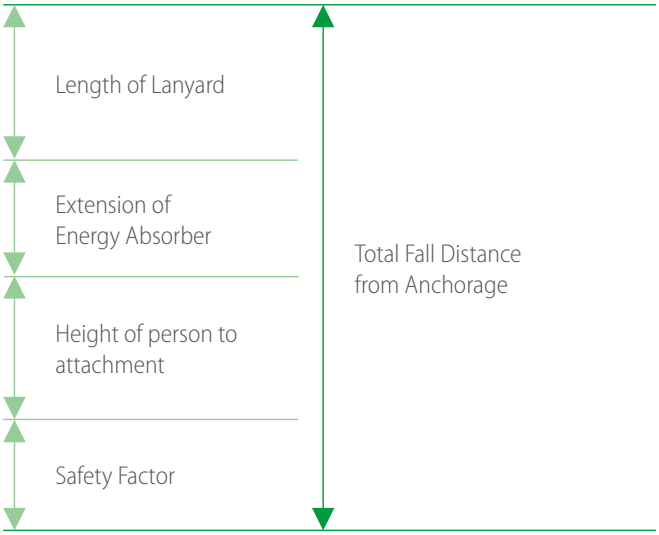




- **Total fall distance from anchorage (as calculated previously):** 6.75m
- **Height of anchor above the working platform:** 2m
- **Total fall distance:** 4.75m (minimum required fall clearance to the ground or obstruction below)

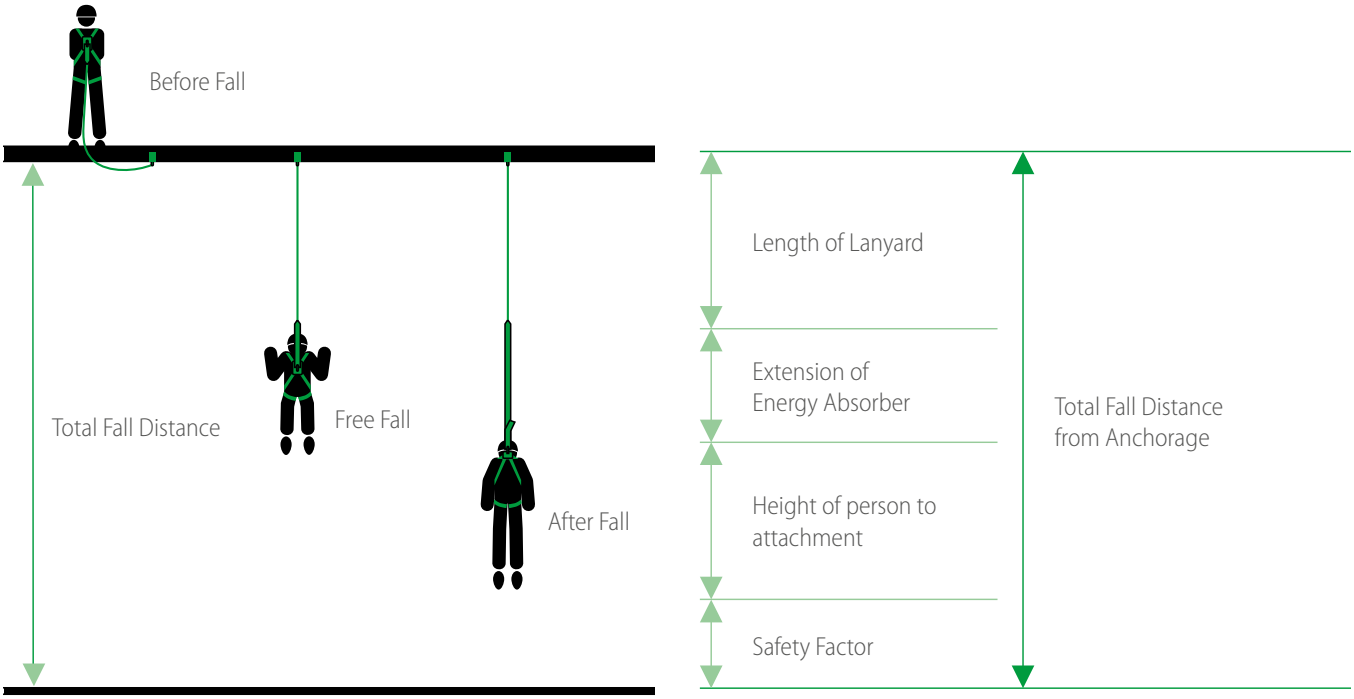
2. Torso-level tie off at **1m above** the working platform





- **Total fall distance from anchorage (as calculated previously):** 6.75m
- **Height of anchor above the working platform**: 1m
- **Total fall distance:** 5.75m (minimum required fall clearance to the ground or obstruction below)

3. Foot-level tie-off at **working platform-level**



- **Total fall distance from anchorage (as calculated previously):** 6.75m
- **Height of anchor above the working platform:** 0m
- **Total fall distance:** 6.75m (minimum required fall clearance to the ground or obstruction below)

Allowing for vertical elongation (VEL) and deflection

In the event of a fall, most shock-absorbing lanyards are designed to have maximum deceleration distance of 1.75m, which includes the VEL. However, if using a rope grab system or horizontal lifeline, or if you were to attach to a non-rigid anchorage connector, the VEL must be calculated based upon stretch of the vertical or horizontal lifelines in those systems and the specifications of fall arrest components. It's essential to check the specific manufacturer's product guidelines for exact stretch figures.

MSA's pre-sales advisors understand the performance and related fall clearance implications and have access to the advanced calculation software required to provide expert insight and advice.

Dealing with limited fall clearances: inertia reel-based solutions

There are many instances where available fall clearances will be insufficient for a conventional lanyard. Examples include scaffolding erection and dismantling, industrial plant maintenance, loading bays, train and aviation applications.

Where a risk assessment shows the available fall clearance for the anchor point and lanyard is not sufficient, alternative options must be used, such as inertia reel-based solutions. Increasingly, Personal Fall Limiters (PFLs) are replacing lanyards and rope grabs as they work to minimize free fall distances.

A synthetic line or metallic cable attached to the worker's harness automatically extends and retracts from a floor or overhead anchored PFL in response to the worker's movement. In the event of a sudden fall, the device automatically deploys an energy-absorbing braking system, arresting the fall within the shortest amount of time, whilst also limiting impact forces on the worker's body.

Crucially, the mechanism engages very rapidly in the event of a fall, typically arresting a descent within inches.

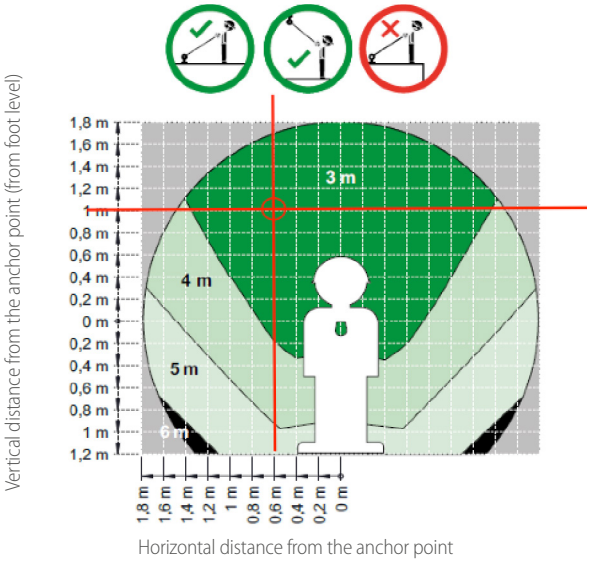
Calculating fall clearance with SRLs and PFLs

MSA has created simple charts to help you calculate the fall clearance required to the nearest obstruction when working with MSA V-TEC™ or V-EDGE™ SRLs or PFLs.

Using the diagram below, simply select the height (in meters) of the anchor point above the working platform, relative to the position of the dorsal D-Ring on the harness (vertical y axis), and the horizontal distance (in meters) to the left or right of the worker (horizontal x axis). The intersection of the two axes indicates the fall clearance zone applicable.

For example:

- PFL anchored 1m above the Dorsal D-Ring and 0.6m to the left of the worker.
- The (0.6, 1.0) coordinate in the diagram falls in the **green 3m fall clearance required** zone.



The importance of training

It is essential that users are deemed fully competent before using any fall protection equipment. They need to be able to check their PPE, identify any risks and understand how to use equipment safely and correctly.

End users should also understand the need for fall clearances and be able to determine and check the fall clearance needed themselves before proposed work commences. A qualified provider should be consulted to provide expert PPE training, and duty holders should ensure appropriate refresher sessions are periodically scheduled.

Summary

It is vital to have a clear understanding of the fall clearances required before commencing any work at height. End users and duty holders should be able to risk-assess and check clearances, assess the anchor options available and understand when insufficient fall clearance prohibits the use of a lanyard.

Inertia reel SRLs and PFLs provide alternative solutions where fall clearance is limited. MSA provides easy to use resources to determine safe fall clearances and can advise on the most suitable and appropriate solutions for many different applications.

MSA—**The Safety Company**

All around the world, people work safely at heights thanks to MSA fall protection systems. With nearly 100 years of experience at the cutting edge of fall protection, MSA sets the standard for innovation, performance and quality. MSA is trusted to ensure worker safety on a wide range of buildings and structures, as well as throughout industries such as aerospace, oil and gas and energy and utilities. MSA's partners offer accredited courses including fall protection, and rescue and equipment inspection. For more information about fall protection requirements for confined spaces, and detection and protection solutions, visit www.MSAsafety.com

Our Mission

MSA's mission is to see to it that men and women may work in safety and that they, their families and their communities may live in health throughout the world.

MSA: WE KNOW WHAT'S AT STAKE.

MSA operates in over 40 countries worldwide. To find an MSA office near you, please visit ***MSAsafety.com/offices***.

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