

# Mechanical and ergonomic criteria in PPE standard: a case study, the CSA Z259.2.1-1998 Fall arresters

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## Standardization context

EN 13921-2007 *Personal protective equipment — Ergonomic principles* is the European base for the integration of ergonomic principles in PPE standards. This standard is sometimes perceived as too difficult to be applied. The CSA Z259.2.1-1998 standard is used as example to demonstrate that mechanical and ergonomic criteria could be integrated successfully in a standard. Also the analysis of accidents and observations of workers show that ergonomic criteria are essential to have PPE offering a real protection.

## Technical context

When working at heights, fall protection is required; protection is either provided by a fall prevention system or a fall arrest system. The individual fall arrest system is used when elimination of the fall hazard by design or when prevention by the use of guardrail is not feasible. The individual fall arrest system is made of a full body harness, an energy absorber, a lanyard, a connecting subsystem and an anchor (Figure 1). The connecting subsystem could be an anchoring connector or a self retracting lanyard or a fall arrester on a vertical flexible lifeline. In the later case, the vertical lifeline is anchored on the roof and suspended along the façade of a building. The worker is then protected along the vertical line.

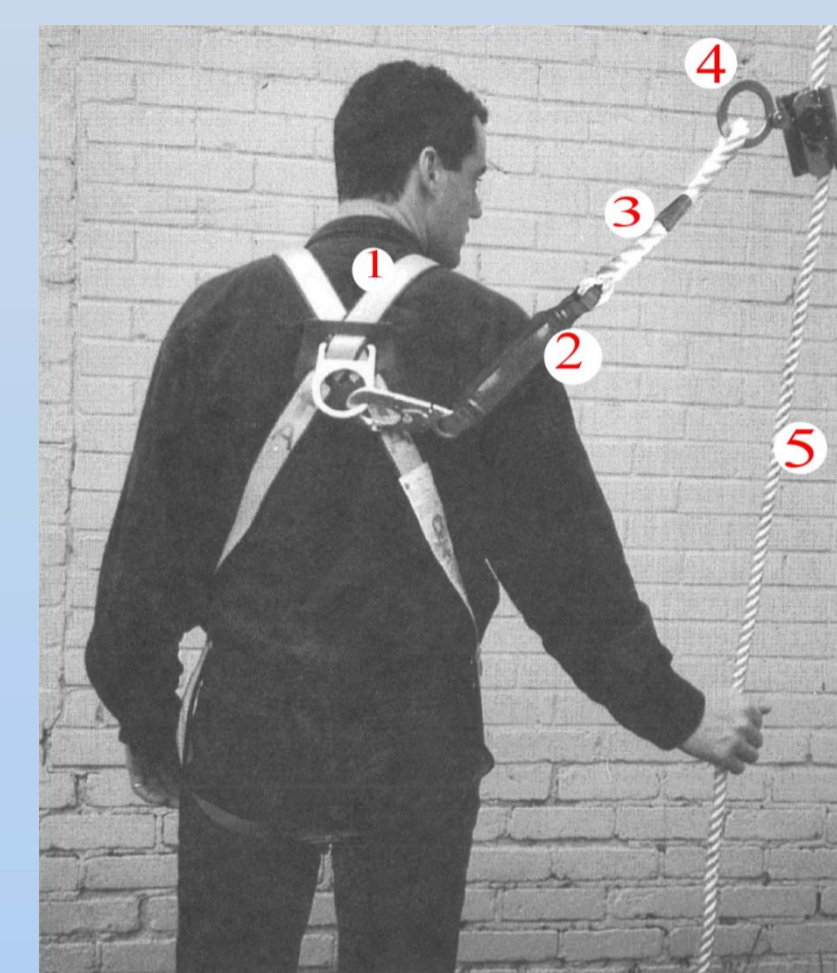
A fall arrester is a device that slides along the vertical lifeline (rope) but locks on the rope if a fall occurs; the locking mechanism is done by a cam lever to which a lanyard is connected (Figure 2).

Because the fall arrester is moving up and down and its stopping is done by the cam lever squeezing of the rope, the compatibility of the fall arrester and of the vertical rope is a key element. A poorly designed fall arrester or an incompatible fall arrester/rope makes the fall arrester not moving easily on rope. This situation obliges the user to maintain the cam lever in an upward position in order to move it up and down when climbing (Figure 3). If a fall occurs during this operation, a natural reflex is to grasp what is in the hand, here the cam lever of the fall arrester; this action maintains the cam in an up position and makes it not functioning.

The fall arrester is overridden and the fall is not arrested. Two well documented fatal accidents and several incidents demonstrated this scenario. The two main concerns regarding the fall arrester were the lack of mobility on the rope and the overriding of the cam mechanism. The lack of mobility is causing a conflict between the need to move up and down (the task) and the protection (do not override the fall arrester cam); the worker is choosing the task because an accident is very uncommon and the task is always present to his mind.

## Discussion and conclusion

The CSA Z259.2.1-1998 standard includes a mobility test and a panic grab test (Figure 4). The mobility of the fall arrester on the rope and thus its compatibility with the rope are verified by. Even if the fall arrester passes the mobility test, it is still possible that the worker grasps the cam lever and overrides the arrest function of the fall arrester. Therefore the overriding of the cam mechanism is verified by a panic grab test; to pass the panic grab test, a fall arrester shall arrest a fall even if the cam lever is in an up position. Since 1998, a new generation of fall arresters was designed; they do not interfere with the task and are fail-safe (Figure 5). Until 2011, the CSA Z259.2.1-1998 standard is the only one covering all these mechanical and ergonomic criteria.



- 1 - full body harness
- 2 - energy absorber
- 3 - lanyard
- 4 - fall arrester
- 5 - vertical lifeline (16mm rope)

Ref.: CSST dc-100-1240-11

Figure 1 - Fall arrester: a component of a individual fall arrest system.



Figure 2 - Fall arrester: A cam lever mechanism which arrest a fall by grasping a vertical lifeline

### Consequences and observations

very frequently workers were observed grasping the lever to move the fall arrester along the vertical lifeline

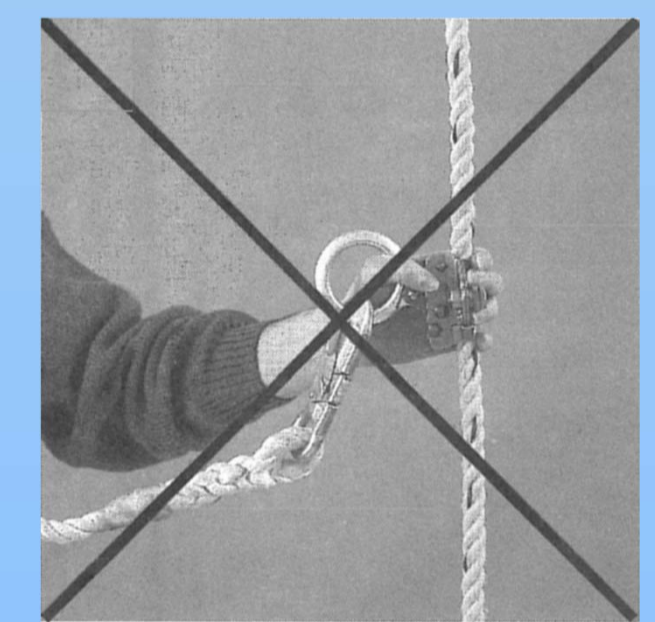
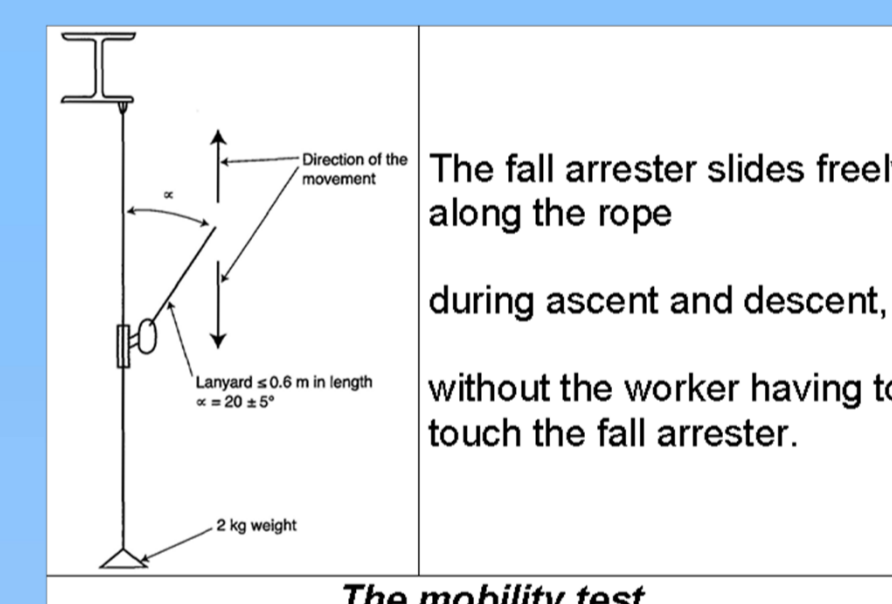
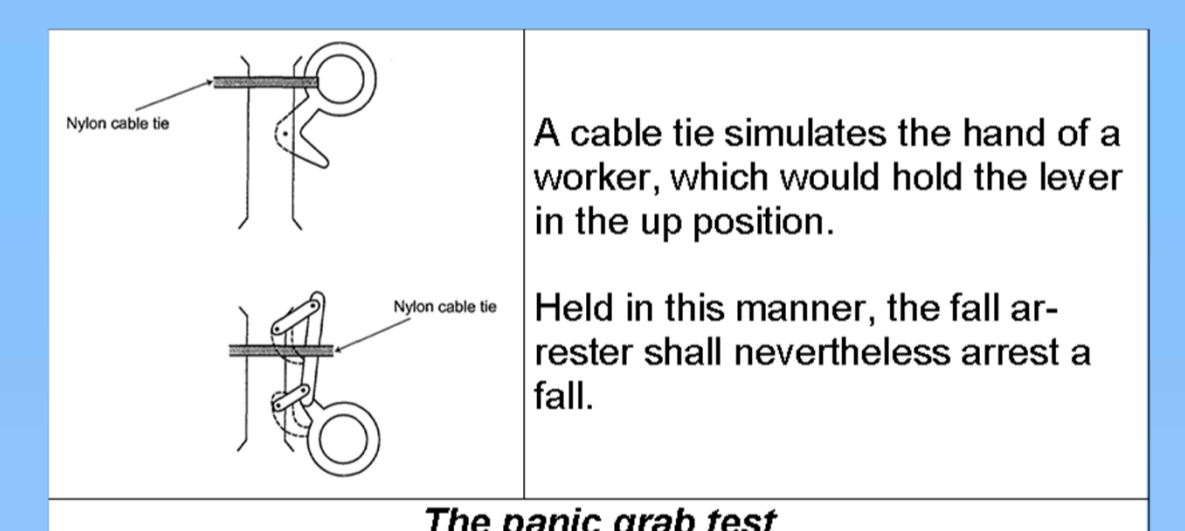


Figure 3 – Incompatible Fall arrester - Rope: the worker maintains the lever up



The mobility test



The panic grab test

Figure 4 – The mobility test and the panic grab test



Figure 5 – Fall arrester incorporating user-friendliness and fail-safe feature

The Z259.2.1-1998 has introduced  
a **userfriendliness** criterion with the mobility test  
= no interference with the main tasks and  
a **fail-safe** criterion with the panic grab test.  
Even if the worker is not acting as trained, the fall arrester will arrest his fall.

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