



Mobile Elevated Work Platforms: Fall Arrest Harness Lanyard Lengths

- Adequate 'Free Fall' Distances

11th October 2010

Introduction

For many years the use of fall arrest harnesses has been required for operators of boom type MEWP's in Australia. These harnesses have been instrumental in saving a number of lives and reducing injuries when occupants have either been bounced out of the platforms or the platform levelling system has malfunctioned and tipped occupants out.

The standard set up in most platforms on boom type MEWP's consists of a full body fall arrest harness and either a 2 metre or 1.8 metre fall arrest lanyard connected to lanyard attachment points positioned typically at heights of 200mm, 600mm or 900mm above the platform floor. The fall arrest lanyard includes an in line energy absorbing device that limits force on the user to less than 6 Kilonewtons (kN) in the event of a fall.

AS/NZS 1891.4 Industrial fall-arrest systems and devices Part 4: Selection, use and maintenance highlights the need for 'adequate free fall distance' in the fall path of the user before the fall is arrested, otherwise the user will strike an obstruction (i.e. the ground) and be injured.

It has been generally accepted that the use of a 1.8 or 2.0 metre lanyard with an energy absorber connected to a fall arrest harness will not prevent the operator from striking the ground in the event of being ejected from the platform when the height of the platform is less than approximately 5.0 metres taking into consideration the lanyard length, height of operator and the 'tear out' distance of the energy absorber.

The Problem:

Some State and Territory Workplace Health and Safety Regulations prohibit the use of fall arrest systems where there is an inadequate free fall distance.

As a result of this some principal contractors have produced guidance documentation that prohibits the use of the existing lanyards and specifies that only **Fall Restraint Harnesses** with **fixed length Lanyards** are supplied with Boom Type MEWP's.

In an effort to provide MEWP users with best practice guidance the Technology Unit of Workplace Health and Safety Queensland (WHSQ) produced a discussion paper and invited the EWPA to further investigate the issue and provide recommendations.

Investigation:

Following the initial work conducted by the Technology Unit of Workplace Health and Safety Queensland (WHSQ), the EWPA have conducted further testing as follows:

A harness and lanyard manufacturer was engaged to conduct 'drop tests' to measure the actual energy absorber 'tear out length' of 1200mm and 1800mm lanyards when connected to 'simulated' MEWP lanyard attachment points at heights of 600mm and 900mm. (See Figs. 1 & 2).

Note: Lanyard lengths do not include attachment hardware e.g. karabiners, snap hooks, dee rings etc.

Mobile Elevated Work Platforms: Fall Arrest Harness Lanyard Lengths

- Adequate 'Free Fall' Distances

11th October 2010



Fig. 1: A 1200mm lanyard 'drop test'



Fig. 2: A 1800mm lanyard 'drop test'

The previously 'drop tested' lanyards were then connected to an operator wearing a fall arrest harness and the actual lanyard attachment points on a MEWP (see Figs. 3 & 4).



Fig. 3: The 1200mm lanyard 'drop tested' lanyard attached to a 900mm high attachment point on the platform.



Fig. 4: The 1800mm lanyard 'drop tested' lanyard attached to a 900mm high attachment point on the platform.

Mobile Elevated Work Platforms: Fall Arrest Harness Lanyard Lengths

- Adequate 'Free Fall' Distances

11th October 2010

The 'adequate free fall distance' between the ground and the height of the platform floor was then measured as follows:

Lanyard Length: **1200mm**

Operator Ejected Over: **Front of Platform**

Platform Size: **1800mm x 910mm**

Lanyard Attachment Height: **900mm**

Energy Absorber 'Tear out' after Fall: **310mm**

MEWP Tested: **JLG 860SJ**

Main Boom Speed: **Approx. 2.5 secs per mtr**

Boom RaiseTime to 2500mm: **6 secs approx**

Adequate Free Fall Distance: 2500mm

Lanyard Length: **1200mm**

Operator Ejected Over: **Rear of Platform**

Platform Size: **1800mm x 910mm**

Lanyard Attachment Height: **900mm**

Energy Absorber 'Tear out' after Fall: **310mm**

MEWP Tested: **JLG 860SJ**

Main Boom Speed: **Approx. 2.5 secs per mtr**

Boom RaiseTime to 1900mm: **5 secs approx**

Adequate Free Fall Distance: 1950mm

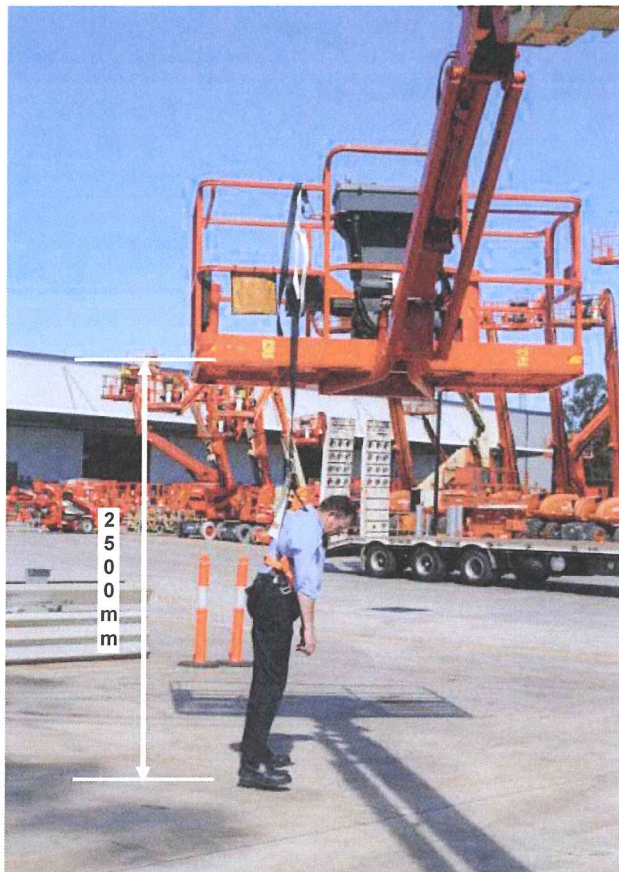


Fig. 5:

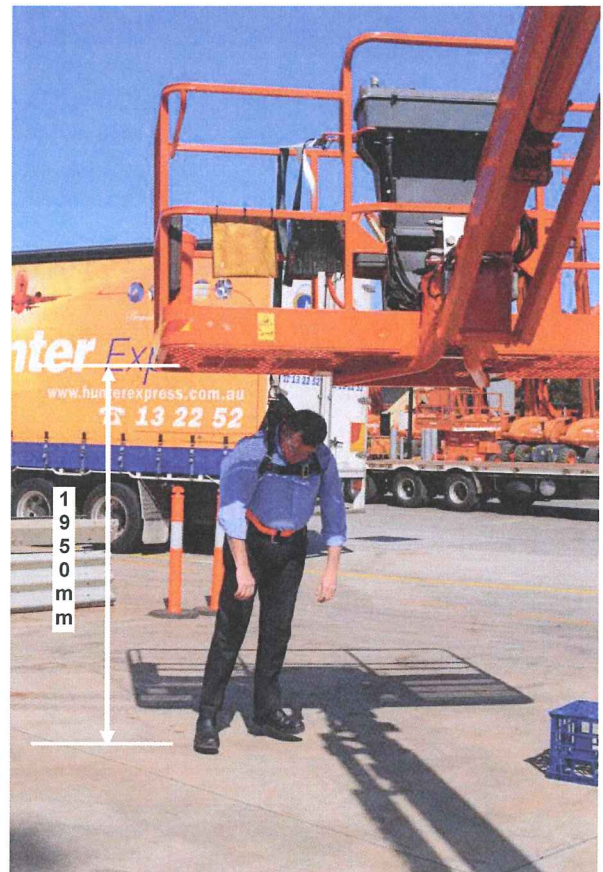


Fig. 6:



Mobile Elevated Work Platforms: Fall Arrest Harness Lanyard Lengths

- Adequate 'Free Fall' Distances

11th October 2010

Lanyard Length: **1800mm**
Operator Ejected Over: **Front of Platform**
Platform Size: **1800mm x 910mm**
Lanyard Attachment Height: **900mm**
Energy Absorber 'Tear out' after Fall: **460mm**
MEWP Tested: **JLG 860SJ**
Main Boom Speed: **Approx. 2.5 secs per mtr**
Boom RaiseTime to 3400mm: **8.5 secs approx**
Adequate Free Fall Distance: **3400mm**

Lanyard Length: **1800mm**
Operator Ejected Over: **Rear of Platform**
Platform Size: **1800mm x 910mm**
Lanyard Attachment Height: **900mm**
Energy Absorber 'Tear out' after Fall: **460mm**
MEWP Tested: **JLG 860SJ**
Main Boom Speed: **Approx. 2.5 secs per mtr**
Boom RaiseTime to 2900mm: **7 secs approx**
Adequate Free Fall Distance: **2900mm**

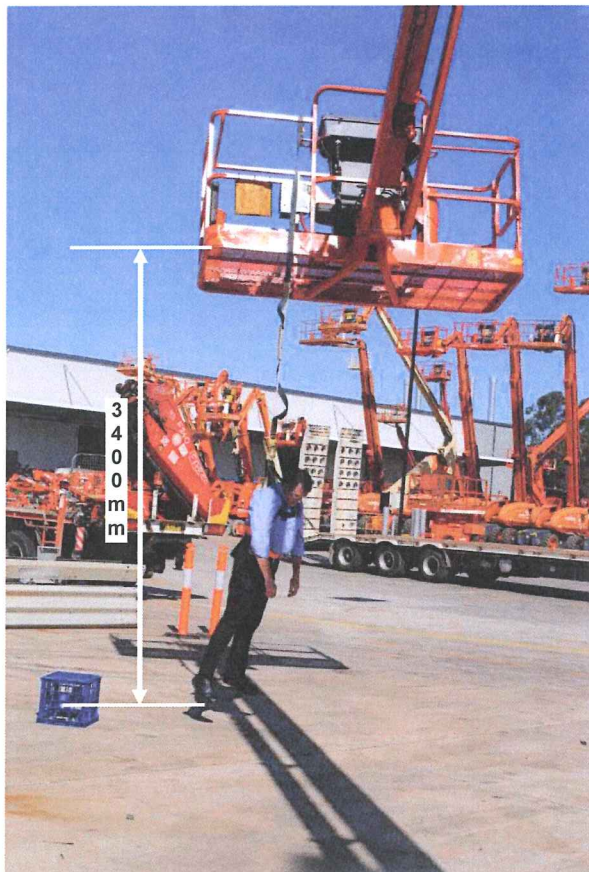


Fig. 7:

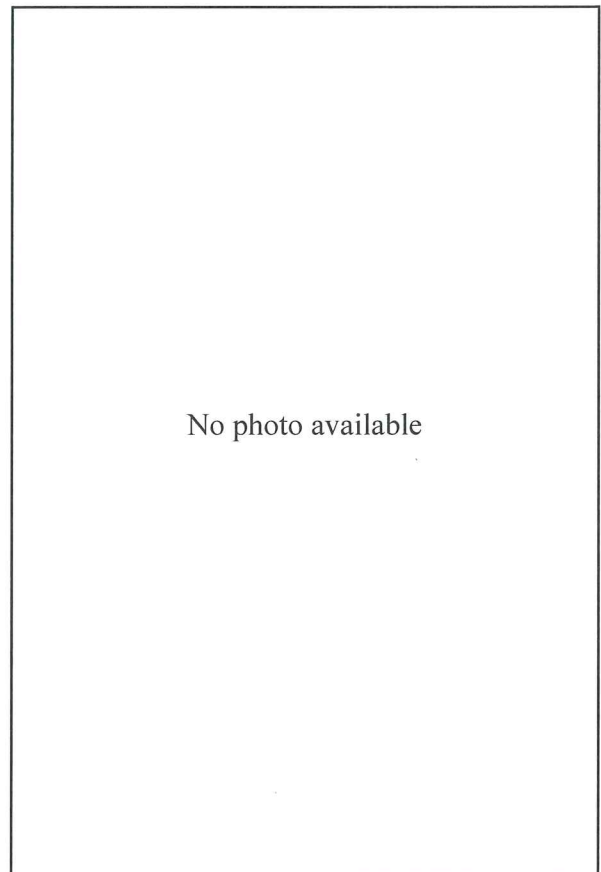


Fig. 8:

Mobile Elevated Work Platforms: Fall Arrest Harness Lanyard Lengths

- Adequate 'Free Fall' Distances

11th October 2010

Lanyard Length: **1200mm**

Operator Ejected Over: **Front of Platform**

Platform Size: **1420mm x 760mm**

Lanyard Attachment Height: **600mm**

Energy Absorber 'Tear out' after Fall: **310mm**

MEWP Tested: **Genie Z34/22**

Main Boom Speed: **Approx. 3.0 secs per mtr**

Boom RaiseTime to 1950mm: **6 secs approx**

Adequate Free Fall Distance: **1700mm**

Lanyard Length: **1200mm**

Operator Ejected Over: **Rear of Platform**

Platform Size: **1420mm x 760mm**

Lanyard Attachment Height: **600mm**

Energy Absorber 'Tear out' after Fall: **310mm**

MEWP Tested: **Genie Z34/22**

Main Boom Speed: **Approx. 3.0 secs per mtr**

Boom RaiseTime to 1950mm: **4 secs approx**

Adequate Free Fall Distance: **1450mm**

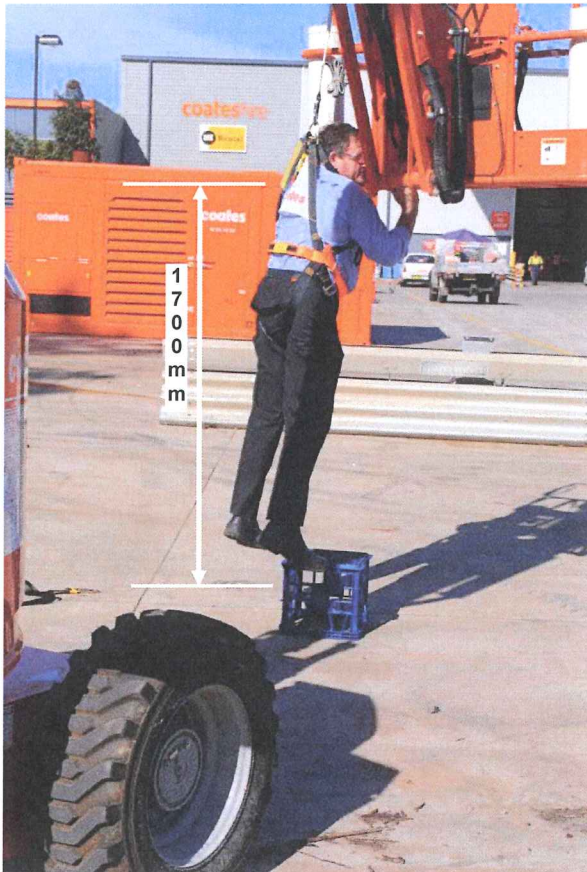


Fig. 9:

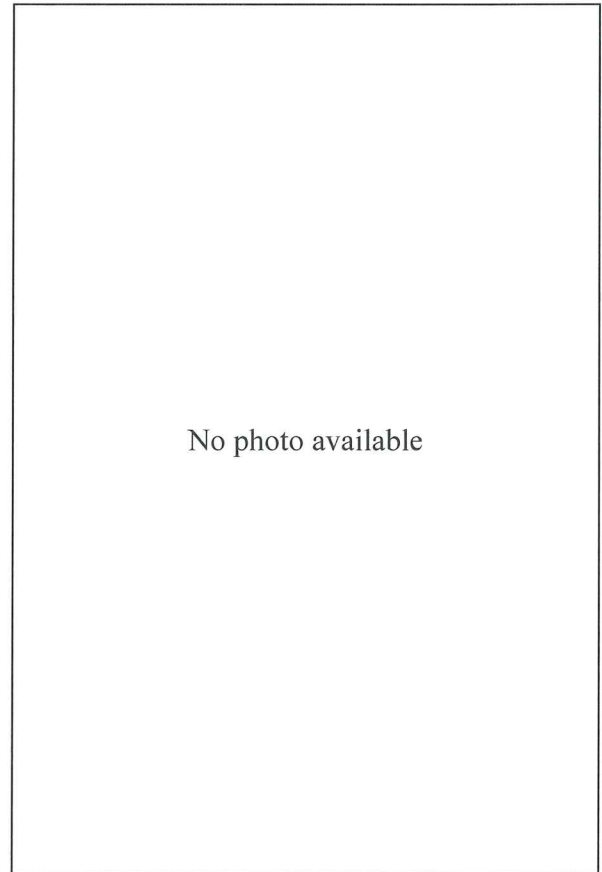


Fig. 10:

Mobile Elevated Work Platforms: Fall Arrest Harness Lanyard Lengths

- Adequate 'Free Fall' Distances

11th October 2010

Lanyard Length: **1800mm**
 Operator Ejected Over: **Front of Platform**
 Platform Size: **1420mm x 760mm**
 Lanyard Attachment Height: **600mm**
 Energy Absorber 'Tear out' after Fall: **460mm**
 MEWP Tested: **Genie Z34/22**
 Main Boom Speed: **Approx. 3.0 secs per mtr**
 Boom Raise Time to 3100mm: **9 secs approx**
 Adequate Free Fall Distance: **3100mm**

Lanyard Length: **1800mm**
 Operator Ejected Over: **Rear of Platform**
 Platform Size: **1420mm x 760mm**
 Lanyard Attachment Height: **600mm**
 Energy Absorber 'Tear out' after Fall: **460mm**
 MEWP Tested: **Genie Z34/22**
 Main Boom Speed: **Approx. 3.0 secs per mtr**
 Boom Raise Time to 2700mm: **8 secs approx**
 Adequate Free Fall Distance: **2700mm**



Fig. 11:



Fig. 12:

Mobile Elevated Work Platforms: Fall Arrest Harness Lanyard Lengths

- Adequate 'Free Fall' Distances

11th October 2010

Testing Summary:

Conducting the 'drop tests' established that there is typically only a difference of 150mm 'tear out' of the energy absorber between a 1200mm lanyard (310mm tear out) and an 1800mm lanyard (460mm tear out).

The 'worst case' demonstrated that an MEWP platform must be at a minimum height of 3400mm to ensure 'adequate free fall distance'.

The 'best case' demonstrated that an MEWP platform must be at a minimum height of 1450mm to ensure 'adequate free fall distance'.

Note: While acknowledging that AS/NZS 1891.4 requires a residual clearance of at least 1.0 mtr below the suspended person this has not been included in these measurements as the purpose of these tests was to establish the minimum platform height required to prevent an operator from contacting the ground if ejected from the platform.

Other Considerations:

1. While the test results conclude that to obtain an 'adequate free fall distance', 1200mm lanyards reduce the minimum height of the MEWP platform they introduce another risk of the operator crashing into the platform following ejection (see Figs 13 & 14).



Fig. 13:



Fig. 14:

Mobile Elevated Work Platforms: Fall Arrest Harness Lanyard Lengths

- Adequate 'Free Fall' Distances

11th October 2010

2. In response to the suggestion by some principle contractors for **Fall Restraint Harnesses with Fixed Length Lanyards**, the following 'drop test' was conducted using an 800mm length of chain to 'simulate' a 'worst case' fixed lanyard without an energy absorber. 800mm was chosen as it is the shortest possible length that can be used to attach to a 600mm high lanyard attachment point on the platform and the front attachment loops on the fall arrest harness when worn by an operator. It should be noted that even when using a 800mm lanyard attached to a 900mm high lanyard attachment point, the operator is still capable of climbing over the front handrails.

Note: AS/NZS 1891.4 states that the maximum allowable length of a lanyard without an energy absorber is 600mm otherwise serious personal injury will occur.

The results of the test concluded the test weight was subjected to more than 18kN of force and actually broke the karabiner being used! (see Figs. 15, 16 & 17).

This 'arresting force' was three times the allowable limit (per AS/NZS 1891.4) and would result in the operator dying from internal injuries.

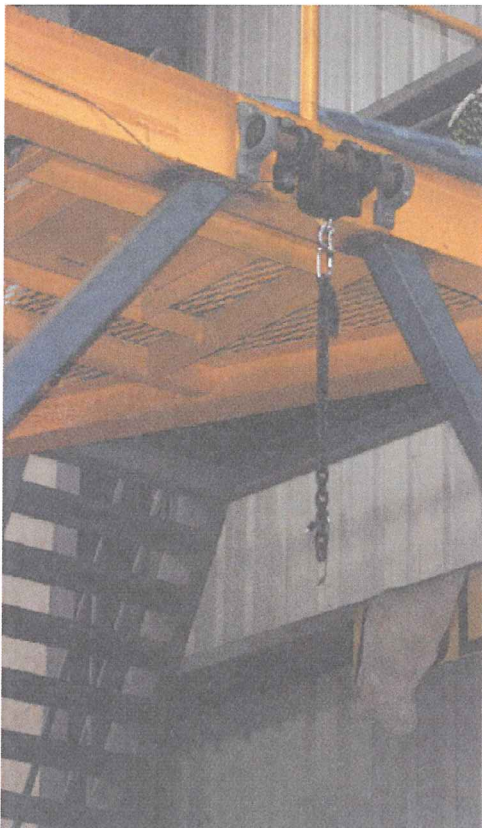


Fig. 15: The broken 800mm chain



Fig. 16: The test weight laying on the floor



Fig. 17: The broken karabiner

Mobile Elevated Work Platforms: Fall Arrest Harness Lanyard Lengths

- Adequate 'Free Fall' Distances

11th October 2010

3. The use of 750mm – 2000mm 'adjustable lanyards' was also assessed with the following observations made:

- There is a risk of entanglement of the 'unused' end of the lanyard in the 'deadman' foot switch located on the MEWP platform floor.
- Damage is likely to occur to the 'unused' end of the lanyard from the operator standing on it.
- Maintenance and reliability issues may occur due to the 'rope grip' mechanism being exposed to the weather.
- Complexity and user acceptance may make implementing difficult.

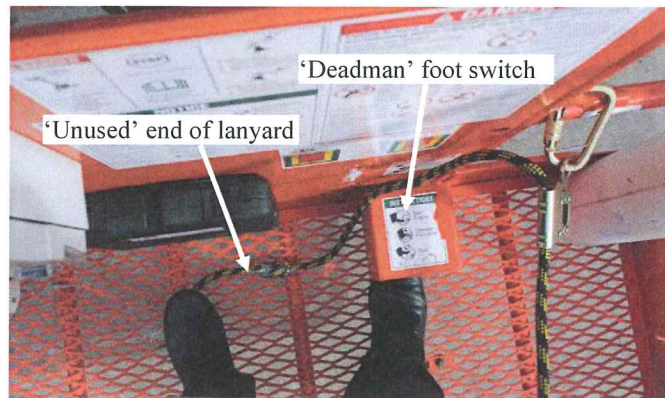


Fig. 18: Risk of entanglement and damage to the 'unused' end of the adjustable lanyard.

Conclusion:

While it is correct to say that wearing a fall arrest harness with an energy absorbing lanyard will not prevent an operator from striking the ground in the event of being ejected from an MEWP platform below certain heights, the actual 'exposure' to this risk is limited.

- The average time taken for the platform to rise above the 'adequate free fall distance' is less typically than 10 secs.
- A MEWP platform is typically used to work at heights greater than the minimum 'adequate free fall distance' required.
- In accordance with AS1418.10, MEWP's are manufactured with peripheral handrails in excess of 950mm high, have self closing gates and additionally have a safety interlock system that reduces the travel speed when the boom is raised above horizontal.
All these features are designed to reduce the likelihood of an operator being ejected from the platform.
- An operator ejected from a platform while attached to a 1200mm lanyard with an energy absorber would likely result in the operator sustaining injuries from striking the platform following the fall.
- An operator ejected from a platform while attached to an 800mm lanyard **without** an energy absorber could result in serious internal injuries and possibly death.

Mobile Elevated Work Platforms: Fall Arrest Harness Lanyard Lengths

- Adequate 'Free Fall' Distances

11th October 2010

Recommendations:

1. A lanyard with an energy absorber should always be used regardless of the length used.
2. When **performing work tasks** in a MEWP platform at **heights where an 'adequate free fall distance' is obtained** (i.e. approx 3.5 mtrs and above), an 1800mm lanyard with a energy absorber is the recommended lanyard to be used. This length lanyard is also suitable when raising the platform from the ground to a height above that which ensures an 'adequate free fall distance' as the period of time the operator is exposed to the risk is limited (typically less than 10 secs).
3. When **performing work tasks** in a MEWP platform at heights where **an 'adequate free fall distance' is NOT obtained** (e.g. less than approx 3.5 mtrs), the following should be considered:
 - Use the shortest possible lanyard with an energy absorber which enables the work tasks to be completed. This may include an adjustable lanyard.
 - Where possible, clear movable obstructions, structures, projections etc from underneath the MEWP platform before commencing work tasks.
 - Implement site specific Safe Work Procedures that prevent the operator from driving the MEWP e.g. the operator would have to either lower the platform to as close to the ground as possible or raise it to height where an 'adequate free fall distance' is obtained before driving the MEWP.
 - Consider other methods of conducting the work tasks.
4. When **travelling** in a MEWP (i.e. moving from one location to another), the following should be considered:
 - Where practical the platform should be kept as low to the ground as possible and the MEWP driven at a speed appropriate to the ground conditions e.g. select 'slow drive speed' when driving on rough uneven ground.
 - Where it is not practical to travel with the platform low to the ground, the platform must be raised to a **height where an 'adequate free fall distance' is obtained** (i.e. approx 3.5 mtrs and above)
 - Travel with the platform elevated shall be only permitted on firm level surfaces free of undulations, obstructions and potholes.

Acknowledgements:

The EWPA would like to thank Height Safety Equipment manufacturers Beaver Brands for their time, test facilities and expertise.