Designer's Guide

uni rail®

uniline®

Always read and follow the warnings and instructions for use

Contents

1. Foreword

It is important that this guide is read and fully understood before the UniRail System is installed or serviced. The UniRail System has been designed to prevent or minimise the risk of injury from falls. Incorrect installation or servicing through failure to adhere to these instructions could result in serious consequences. Part of these procedures fulfil the requirements in BS EN 795 and BS 7883 and is OSHA compliant, failure to comply with the above could also result in non-compliance with these standards. Another part of these procedures comply with the requirements in Directive 89/686/EEC, so failure to comply with the above could also result in noncompliance with legal requirements. It is important that supervision and management ensure that personnel who they direct to install or service the UniRail System are trained to the standards expected by Uniline Safety Systems Ltd.

This guide is an essential reference document for designing a UniRail system.

2. General

2.1 Authorised Installers

Only competent installers authorised by Uniline Safety Systems Ltd are allowed to install and service the UniRail Safety Rail System.

2.2 Conformity

The UniRail System is a horizontal rail system which is tested and where appropriate certified in accordance with the requirements of British Standard BS EN 795 (Class D), the Australian Standard AS/NZS 1891.2 and is OSHA compliant. It meets the requirements of Council Directive 89/686/EEC by way of the UK transposition of 89/686/EEC: the Personal Protective Equipment (EC Directive) Regulations 1992.
Components or parts are not to be altered, modified, dismantled (beyond that allowed in this manual) or be replaced with items not supplied or manufactured by Uniline Safety Systems ltd., such action will invalidate the above certification and could result in serious or fatal consequences. Parts or components not supplied by Uniline may be of inferior specification and may cause incorrect operation of the system.

2.3 Fall Restraint, Fall Arrest & Suspended Access

The UniRail System is a complete fall protection system. It has been designed to solve problems relating to falls from a height. All UniRail systems for structure`s must be designed for fall arrest, although it is best to restrain the user to prevent an arrest occurring.

FALL RESTRAINT

The advantages with fall-restraint are that:

- Workers do not have to be subjected to the abrupt impact of an arrest as would be the case in a fall-arrest system, or risk falling into a hazard e.g. water or a hazardous substance;
- The user can not be injured from swing-fall incidents.
- There is no need for any rescue provision.
- Personnel require less training.

In a fall restraint system, to prevent the worker from entering an area where they could fall, there are two dimensions which need to be strictly controlled:

- The lanyard length A (Fig 1)
- The distance from the rail to the fall hazard B (Fig 1)

A scale drawing should be made to ensure that the lanyard (including connectors) will always prevent the user from entering a fall arrest situation. If the position of the fall hazard relative to the rail varies this analysis should be performed at various points along the length of the system. Where a rail runs perpendicular to an edge of a flat roof, it must be terminated prior to the edge, so that the extremity of the system acts as the restraint. If the system is terminated at the edge, there is the certainty of free fall and this cannot be classed as fall-restraint.

Fall Restraint Orientation

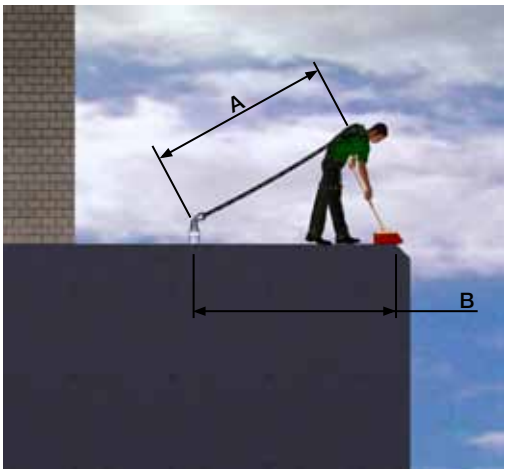


Fig. 1

Fall Arrest Orientation

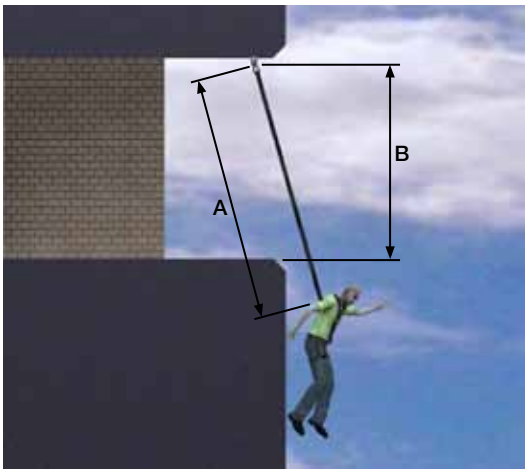


Fig. 2

FALL ARREST

Where a fall-restraint system cannot be employed, a fall-arrest system has to be used. The disadvantage is that a worker has to fall before the system can operate (Fig 2) and arrest the fall. This is achieved by applying a braking force to the worker for a few hundredths of a second. The mechanism of the system ensures that the braking force is always kept below a level of 6kN (1350lbs), providing that the worker is wearing a full body harness certified to the appropriate national standard, and is connected to the carriage by a energy-absorbing lanyard certified to the appropriate national standard.

After the arrest process and having being brought to a complete halt, the worker may be suspended in mid-air. Whilst it might be possible to reach part of the structure in order to regain support, it is normally the case that the worker will have to wait for rescue. During this time the weight of the worker has to be supported by the straps of the harness (orthostatic suspension). This can have a worsening effect on the circulatory, breathing and metabolic performance of the body. It is therefore imperative that the suspension time is kept to a minimum and that the worker is brought back to a position of safety as soon as it is possible by rescue or other means. (Refer to 3.6 Rescue Planning)

SUSPENDED ACCESS

For difficult to access areas a suspended access system may be used to allow a trained worker to rappel from the system. This type of system is best suited to light to medium duties, such as inspections, window cleaning, and light maintenance tasks. It is not recommended for use where the task requires a long period of exposure, the use of heavy equipment, or where the task requires the handling of large quantities of materials.

The continuous UniRail system gives the user the ability to easily position themselves at any point along the system, as well as being able to reposition themselves without ever having to detach from the system, meaning the user is always protected.

Suspended access systems should always be specified to be suitable for fall arrest, as there is always the possibility that the user may fall on the system. Suspended access systems use intermediate brackets that are closer together in order to prevent deflection of the rail under load and to reduce any risk of fastener fatigue caused by repetitive loading.

2.5 Rail Mounting Orientation

Fig. 3

Fig. 4

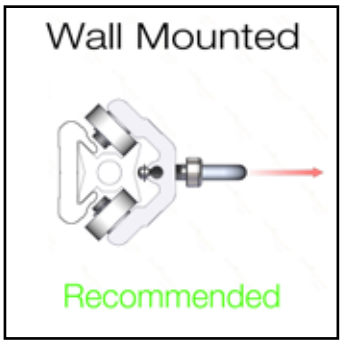


Fig. 5

The rail can be installed in an;

- Overhead orientation (Fig 3), e.g. a crane arm, or overhead gantry.
- Floor mounted orientation (Fig 4), e.g. open sided walkways
- Wall mounted orientation (Fig 5), e.g. historic and commercial buildings.

The installation of the UniRail System with the rail in a non-horizontal attitude (i.e. either in an inclined or vertical attitude) is currently not permitted.

2.6 Recommended Free Space & Free Fall Diagrams

It is important that the installer ensures that the necessary vertical distance required to arrest the fall of a worker does not exceed the vertical distance available on site. In order to arrest a worker, fall arrest systems dissipate the energy generated in the free fall by applying an upward arresting force over a distance, the "arrest distance". In order to prevent the possibility of a collision, there must be sufficient free space directly under the worker for the fall to be arrested in. The free space must be greater than the arrest distance. Free space means that the path of the fall is free from obstacles.

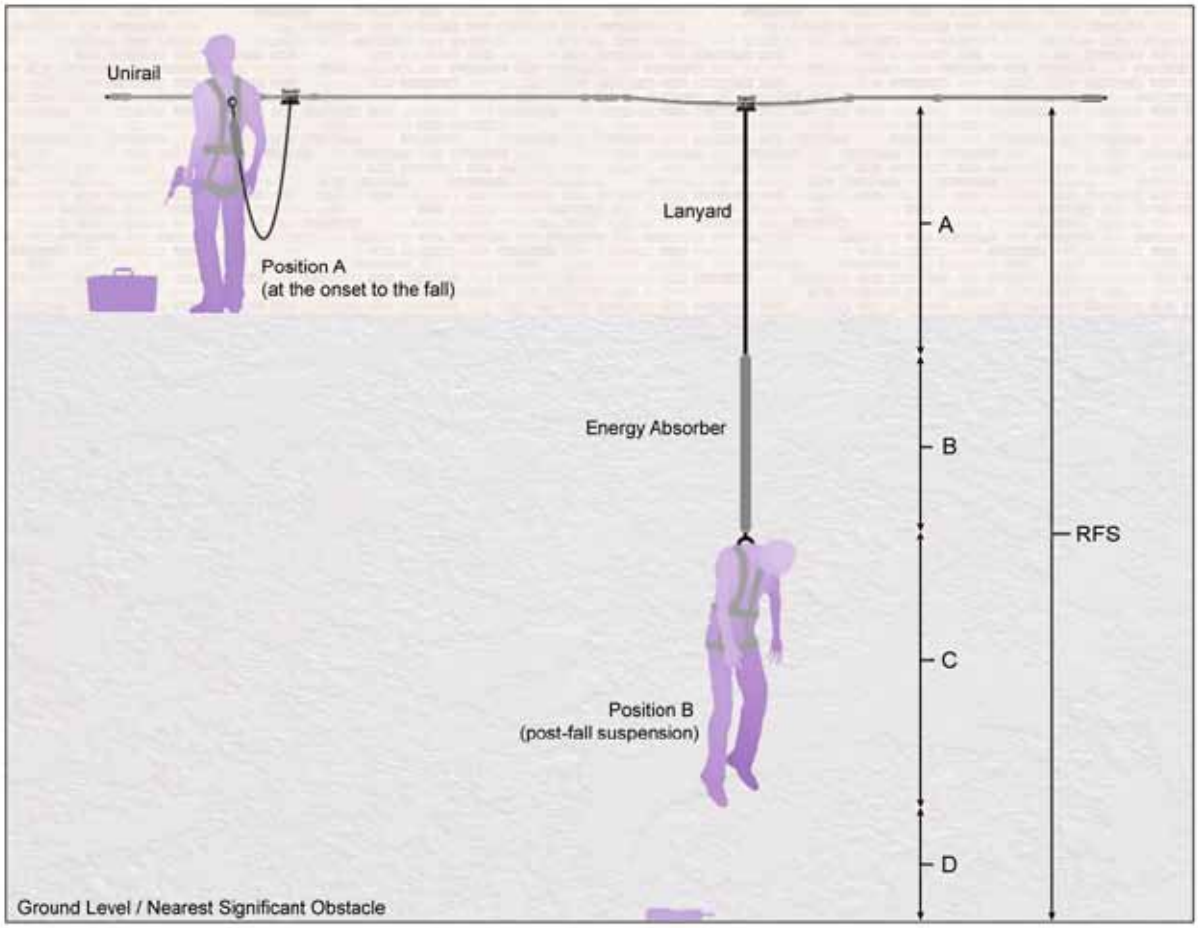


Fig. 6

The Recommended Free Space (Fig 6) is the vertical distance measured from the rail to the ground level, the next lower substantive platform, or nearest significant obstacle, depending upon the application. Application of the RFS ensures the safe arrest of a faller and avoids the possibility of a collision.

The RFS is affected by the length of the free fall and the mass of the worker, as this will determine the energy absorber deployment and rail deformation. It can be calculated by using the following formula:

RFS = Lanyard Length + Deceleration Distance + Height of Worker + Safety Margin (Fig 6)

Lanyard Length
(A) = Length of lanyard + Length of energy absorber + Length of connectors

Deceleration Distance
(B)= Fall Arrest Activation Distance + Harness Stretch + Deflection in Rail

Height of Worker
(C)= Height of the Harness Attachment Point Above Foot Level

Safety Margin
(D)= Minimum Height of the Workers Feet Above Ground Level / Nearest Obstacle.

With all dimensions in the same units of measurement.

Note: this formula only applies to the UniRail System when used with full body harnesses, energy-absorbing lanyards and connectors.

In addition to an energy absorbing lanyard as described in the example and shown in Fig 6, other fall protection devices such as Self Retracting Lanyards and Fall Arrest Blocks (Inertia Reels) also provide effective fall arrest solutions. Uniline will be pleased to advise on the suitability in relation to your planned installation and also supplies a range of these devices. Self retracting fall arrest devices can be effective in reducing the RFS. For "Lock on" distances following the onset of a fall, consult the manufacturer.

DEFLECTION TABLE

Maximum deflection will occur if a user falls with full force, mid span when the rail is fixed at 3m (118.1") centres. The data in the table below should be used as a guide for the "Deflection in Rail" detailed in the Deceleration Distance (B)

No. of users	Deflection (m)	
	Side fix	Concealed fix
1	0.28m (11")	0.34m (13.4")
2	0.56m (22")	0.67m (26.4")

2.6.2 Free Fall Diagrams

Freefall is the vertical displacement of the users fall arrest attachment between the onset of the fall and just before the system begins to react by applying force to arrest the fall. Systems should be designed to limit free fall as much as possible.

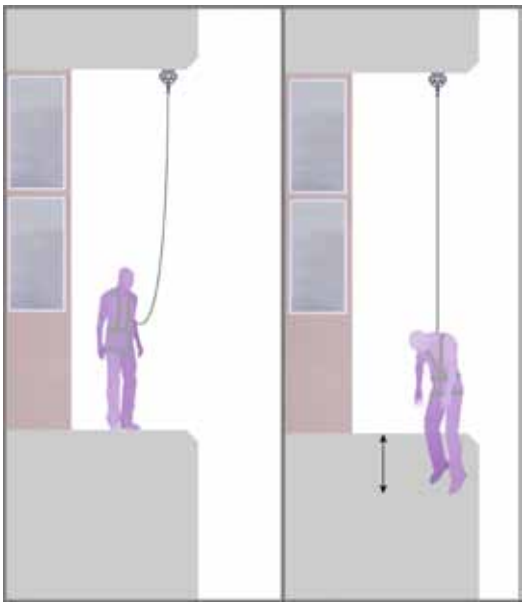


Fig 7 Ceiling mounted - overhead
Fall Factor 0

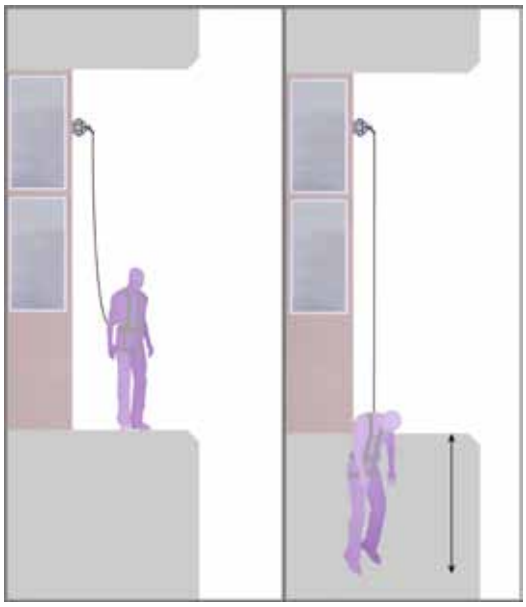


Fig 8 Wall mounted - overhead
Fall Factor 0.5

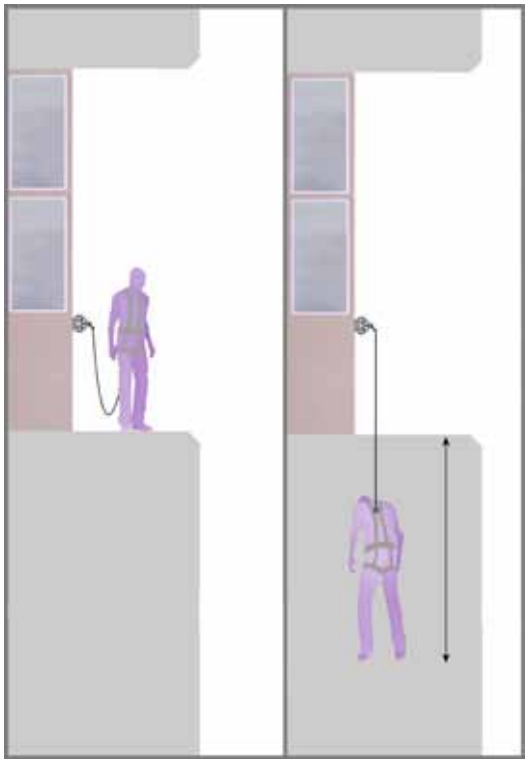


Fig 9 Wall mounted - waist level
Fall Factor 1

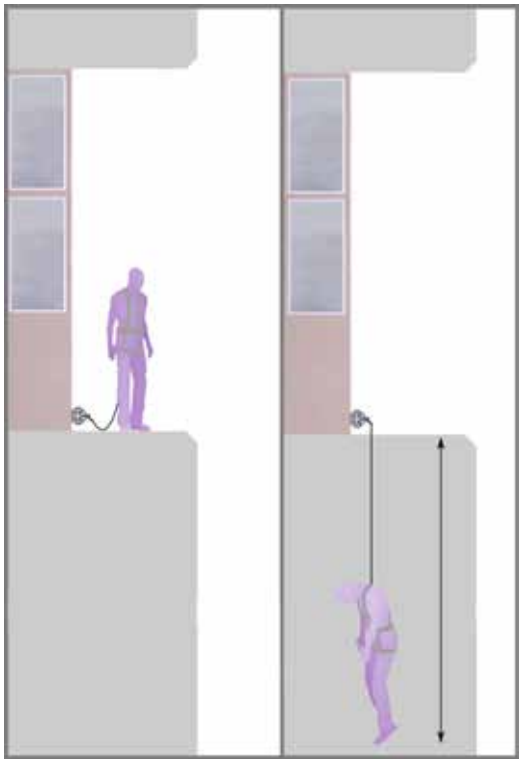


Fig 10 Wall mounted - floor level
Fall Factor 2

3. Site Assessment

3.1 Reviewing the Task

Only installers authorised by Uniline Safety Systems Ltd are allowed to install and service the UniRail Safety Rail System.

SITE SURVEY

At the start of each job a site survey should be carried out to assess the type and location of the system required.
Accurate measurements should be taken to make sure that the system will fit the required area correctly. Special consideration should be given to systems where corners are required, as this will affect the type of brackets that can be used, and how the system is to be fitted. Concealed fix systems require the rail to be slid into place after the brackets have been fixed, it is important to check if this is possible. If not side fix brackets may need to be specified.

During a site survey the following information should be gathered:

- The purpose of the system / Task to be performed
- The maximum No. of people that will be using the system at any one time.
- The structure the system is to be mounted to
- Scale drawings of the structure or building (in digital format if available)
- The exact path of the system
- Any special requirements from the architect or the customer such as; a specific type of bracket, or particular considerations for historical buildings.
- The risks to the installers so that suitable risk controls during installation can be planned.

When seeking technical support on a specific job, the Uniline Safety Systems sales team will be able to help you more quickly if you have the above information available as a minimum.

DRAWINGS

Only accurate scale drawings provided either by the architect of the structure, or drawn from a comprehensive site survey should be used when detailing and specifying a UniRail system, to prevent changes needing to be made by the installer on site when the system is fitted.

METHOD STATEMENTS

Before work begins a method statement should be written by the installer, agreed with the client and signed by both the parties. This is a detailed step by step guide of how the work is to be carried out by the installer.
The method statement protects both the client and the installer in the event of the work not being carried out in a safe manner, and can be used to ensure that the workers are adhering to safe and suitable working practices while carrying out the work.

3.2 The Mounting Structure

UniRail can be or has been fitted to:

- Concrete
- Brickwork
- Steel Angle
- Steel Box Section
- Fibreglass with a steel sub frame
- Fascias with a sub structure

Before specifying UniRail the details of the system should be checked by a structural engineer to ensure the two are compatible.
Minimum load tests must be performed by the installer to verify the structure.

Later in the manual there are details of fasteners/anchors to suit your structure

3.3 Gaining Access to the System

The entry point is defined as the point where the user can attach to the system. The exit point is defined as the point where the user can detach from the system. The entry point and the exit point can be at the same position.
It is important to remember that the user is not fully protected from a fall until the carriage is fully engaged onto the system, the tamper proof stop is fitted and the user is connected to the carriage. Or, in the case where the carriage is permanently fitted to the system, until the connection between the carriage, safety lanyard and harness is made.
In planning the configuration of the system, adequate consideration should always be given to the positioning of the rail in regard to the above. The entry point should always be in a safe area, i.e. free from fall hazards. Where this cannot be achieved, a secondary means of fall protection needs to be installed to give protection whilst bridging the gap between the access route and the UniRail System.
The same consideration needs to be made in respect to the exit point, should it be in a different position to the entry point.

3.4 Environmental Conditions

BIMETALLIC CORROSION

Bimetallic corrosion (or Galvanic Corrosion) is the accelerated corrosion of one metal placed in contact with a different more noble (less corroding) metal. It generally occurs around fixings such as nuts and bolts, rivets or welds in situations where different metals are in contact and can become wet. In the case of the UniRail product stainless steel is more noble than 6000 Series aluminium alloy, but the two metals are close to one another in the nobility table so corrosion is extremely unlikely. If any corrosion were to occur it would occur on the less noble material, in this case the aluminium rail.

Uniline use Stainless Steel A4 70 fasteners where ever possible as they offer excellent corrosion resistance for the wide range of environments that we expose our systems to. “A4” signifies that the fastener is made from the most corrosion resistant austenitic stainless steel. “70” relates to 1/10th of the tensile strength of the fastener. So a fastener with a rating of 70 has a tensile strength of 700 N/mm^2.

ENVIRONMENTAL PERFORMANCE OF ANODISED UNIRAIL

UniRail Products are designed to withstand the most severe environmental conditions. We use 6000 Series aluminium alloy and stainless steel throughout the range. The rail is anodised to 25 microns (AA25) this is the highest anodising standard, commonly used where products are exposed to severe stress in the form of corrosion and abrasion.

- There are four stages to the anodising process: pre-treatment, anodising, colouring and sealing.
- Pretreatment removes dirt and impurities from the surface of the aluminium.
- Anodising - makes the component the (anode) in an electrolytic cell. Dilute sulphuric acid is used as the electrolyte. The electrolysis oxidises the surface. The process continues until the required thickness is reached. (25 microns for UniRail)
- Colouring –If a colour is required then the components are exposed to an AC current. The AC current precipitates the pigment to the base of the oxide layers pores.
- Sealing – The oxide layer contains a large number of pores, to obtain an impermeable surface the pores have to be sealed. The sealing is achieved in de-ionised water at 95 – 98°C. This changes the aluminium layer into Bohemite, increasing the volume of the protective layer and in turn closing the pores.

As previously mentioned the corrosion resistance of the anodised UniRail components is excellent, especially where the pH is between 4 to 9 (pH 0 = Strong Acid, pH 14 = Strong Alkaline). Strong alkaline substances such as lime, cement and gypsum commonly found on building sites can stain and damage the anodised finish. If a UniRail system is knowingly going to be exposed to these materials during its working life contact Uniline for further assistance.

THE EFFECT OF TEMPERATURE ON UNIRAIL

The coefficient of thermal expansion of 6000 Series aluminium alloy is relatively high at $23x10^{-6}$/°C. The effects of temperature variations have to be taken into account as the resultant expansions and contractions can induce stress.

Fig 11 Initial Gap at normal temperature

Fig 12 Expanded Gap at high temperature

In a 10m (393.7in) straight section of rail with a temperature change from 10°C (50°F) to 40°C (104°F) you would expect to see the rail expand by 7mm. This is found by the following formulae:

(Change in temp x the coefficient of thermal expansion x length of rail)

$30°C \times 23 \times 10^{-6} \times 10m = 0.0069$ m.
$54°F \times 12.3 \times 10^{-6} \times 393.7in = 0.26in$

The safe operating temperature range for the UniRail product is -50°C (-58°F) to 150°C (302°F) (excluding any rubber or plastic components). For specialist applications in extreme temperatures contact Uniline Safety Systems.

3.5 Environmental Impact

As one the leading manufacturer's of fall protection products Uniline are aware of the impact that our products and services have on the environment. Uniline are committed to understanding and communicating these impacts to our customers as part of the continuous development of our environmental policy.

The aluminium economy is a circular economy. Aluminium is 100% recyclable without any loss of its natural qualities. Recycling involves melting the scrap, a process that requires only five percent of the energy used to produce aluminium from ore. In addition, recycling of aluminium products only emits 5% of the greenhouse gases emitted in primary aluminium production. Our manufacturer has remelting facilities in the UK and 50% of their production is based on recycled Aluminium.

The extrusion of UniRail starts with aluminium alloy Ingots, these are cut into billets and then heated to extrusion temperature. Pressure is then applied to force billet through a die. Once the profile emerges it is the cooled via air or water. Extrusion allows for metal to be placed where it is needed most therefore maximizing material use. Any waste Aluminum is recycled, remelting facilities are enclosed to monitor and contain gas emissions during the process.

3.6 Rescue Planning

The Working at Height regulations requires the employer to make specific provisions for emergency planning. Work should be appropriately planned and previsions should be made for emergency situations. The need for rapid and appropriate response following a fall should not be ignored. Being suspended whilst unconscious for any length of time, in extreme scenarios can lead to death, therefore it is important that rescue planning is taken seriously.

It is important to establish whether you are planning for a "rescue" or an "evacuation" as this can affect the equipment and training required. A rescue is usually the recovery of a casualty by another person. An evacuation is typically carried out by a trapped user to escape from a remote situation.

Having recognised the need for timely rescue and evacuation it's vital that adequate resources are in place for each work site. Resources should include rescue/evacuation equipment and personnel who have been trained to use the equipment. In addition to this personnel should receive first aid training to enable them to manage a victim who is unconscious or in medical distress.

For further information visit www.unilinesafety.com

When planning a rescue/evacuation the following should be addressed:

- The safety of the person carrying out the rescue
- The anchor points to be used for the rescue equipment
- The suitability of the equipment for the specific rescue/evacuation scenario
- The method which will be used to attach the casualty
- The fall protection system which the casualty will be using
- The direction the casualty needs to be moved to get them to a position of safety
- The needs of the casualty following the rescue
- The number of people required for the rescue
- A method for effective communication between the rescuer and the casualty

When working at height a sensible strategy is to employ two workers for the task, so if one falls, the other can assist in the rescue, or can summon help. High visibility clothing, whistles and personal alarms are all items worthy of consideration. Before performing a rescue assess the following:

- Assess the situation to make sure that a rescue needs to be performed
- Alert the emergency services
- Identify anchorage points
- Identify where the casualty will be moved to
- Make sure all members of the rescue team know their role within the procedure

Most procedures will recommend that the emergency services are called and informed of the situation so the appropriate assistance can be mobilized. In many circumstances, particularly in metropolitan areas, such a response may be sufficient, however in remote/exposed situations the capability of the emergency services is limited. Operatives will require the competence, equipment and procedures to initiate rescue and evacuation independently.

In which case the following factors should be explored:

- Consider Personal Protective Equipment, anchorages and procedures that reduce shock loadings and fall distances.

- Pre position or have available access equipment such as Mobile Elevated Work Platforms or platforms that will enable simple rescue and evacuation as required.

- Consider the use of specialist rescue and or evacuation devices - on the basis that they will be infrequently used, operated by non professional trained operators and should therefore be as 'fail safe' and technically simple as possible.

Uniline offer a range of rescue devices, contact Uniline for further details.

4. Designing Your System

4.1 Specifying the System

Only installers authorised by Uniline Safety Systems Ltd are allowed to install and service the UniRail safety rail system.

4.2 Concealed Fix verses Side Fix

The table below has been formulated as a quick reference guide to help you correctly specify the most suitable mounting type for the application.

Specification of the type of mounting should always take into consideration the type of structure being attached to, the environment into which the product is being installed and the required frequency of inspection. Some examples of common considerations are detailed at the end of the table. For a-typical applications or if you are unsure about what type of system to use after reading this guide please contact Uniline for advice.

MATRIX

Product Performance: Excellent ++ Good +

Benefits	Side Fix 	Concealed Fix 
Ease of fixing	++	+
Cost effectiveness	+	++
Load back to structure	++	+
Ease Of Maintenance	++	++
Visual impact	+	++
Ease of examination	++	+
Time taken to install	+	+
Environmental performance	++	++
Corrosion resistance	++	++

CONCEALED FIX SYSTEMS

A concealed fix system is specified when:

- The visual impact of the product on the structure is of importance, such as historic buildings, as the hidden fixing points provide a cleaner and less noticeable finished look to the system.

- It is believed that there is the possibility of the system being tampered with, as the fixings are concealed behind the rail and inaccessible unless the rail is removed.

- The installation is required into very hard materials, such as structural steel work, or stone masonry, as the reduced number of fixings means that less anchor points need to be drilled and set by the installer.

- Fixing through the structure, where both sides are not accessible at the same time, as the tapped intermediate bracket can be used to prevent the bolt from spinning on the rail side, allowing the correct torque setting to be applied.

- Cost effectiveness is a priority for the customer, as the system uses lower profile brackets and a reduced number of fixings. This can help to keep the initial cost of the system down, when being fitted by a trained and experienced installer.

- For overhead mounting situations, it may be beneficial for the installer due to the reduced amount of overhead drilling that is required for the installation. All of the brackets can be fixed to the structure, and then the rail can be slid onto the brackets.

SIDE FIX SYSTEMS

A side fix system is specified when:

- Installing in harsh environments where a more detailed and greater frequency of inspection may be required. The fixings are easily visible so it can easily be highlighted by the user or inspector if there is a problem which needs to be rectified.

- A weaker structure is being attached to, or the structural strength of the material can not be consistently determined by a structural engineer, this system is more suitable, as the load is spread across two fixings rather than just one at each anchor point.

- The rail is being installed on a structure which requires complex bends, or the system is being installed in an unfamiliar environment. The accessible position of the fixing points allows the installer to hold the rail in place with the brackets in the correct position. The holes can then be drilled, and the fixings set in one operation.

4.3 Forces on the system

The UniRail system complies with the EN795 class D standard. It has also been tested extensively by Uniline. We find that a rail system reacts differently from a traditional cable system. A cable system transfers high loads (Approx 20kN (4496lbf)) to the end anchors in the event of a dynamic load being applied.
When a dynamic load is applied mid span between anchors on a UniRail system it is typical for the load to be shared between these anchors. The load at the end anchor is minimal. The only exception to this is when a fall occurs on the end section of the system. The greatest load generally seen on a system is when a fall occurs directly over an intermediate bracket. Users of the system MUST all use Energy Absorbing Lanyards which conform to the appropriate national standard. The lanyard has to limit the load on the user to less than 6kN (1350lbf). One user can fall directly on the carriage over the intermediate then this is the greatest load seen on the system. A load of 12kN (2698lbf) could be applied if two users were to fall at exactly the same time and their arrest force was transferred at the same time. The load of 12kN (2698lbf) is equally shared between the two adjacent mounting brackets, 6kN (1350lbf) each (Fig13). In most scenarios this is expressed as shear force on the fastener. Typically for the testing performed all of the peak energy generated in a dynamic fall has been absorbed within 3/10th of a second.

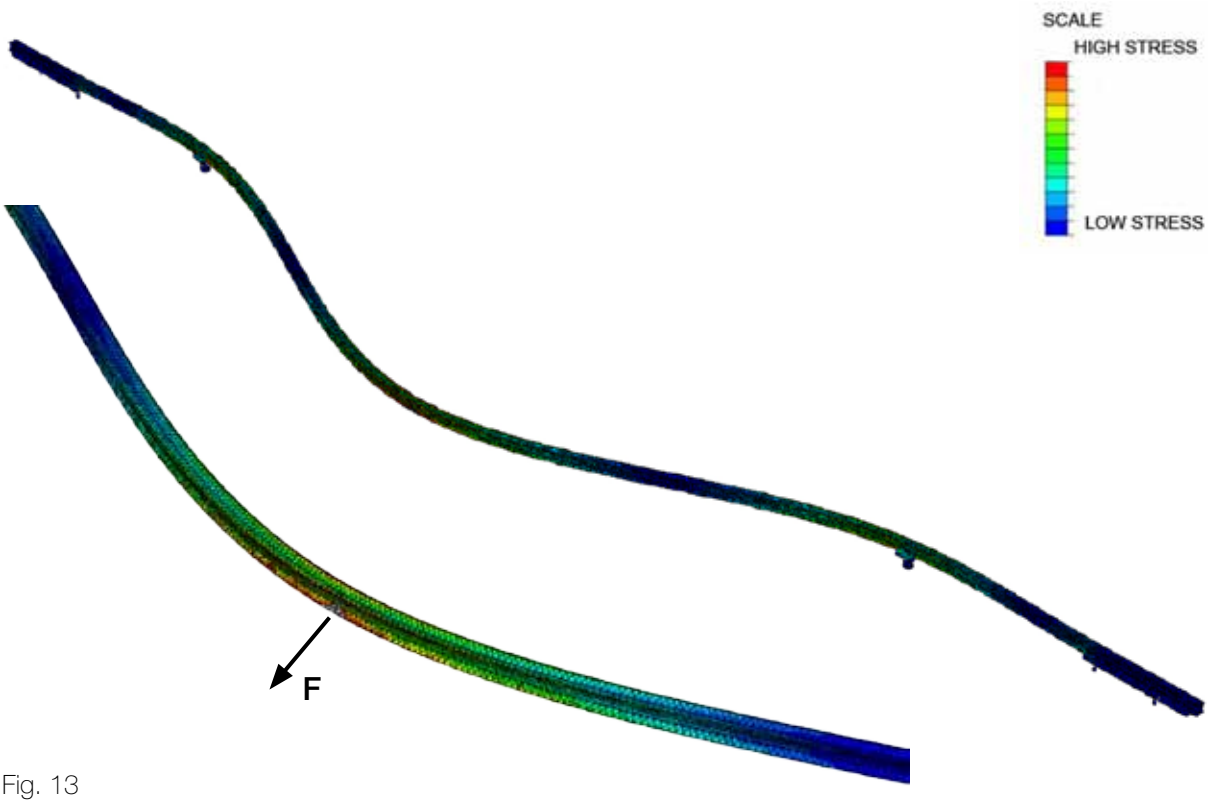


Fig. 13

The static finite element analysis above shows rail deformation mid span at 12kN (2698lbf), the deflection has been amplified for illustration purposes. The maximum deflection is 0.67m (2' 2.3"). The rail is starting to plastically deform at this load to take a permanent set.

As part of the ongoing development of the UniRail product we are now performing FEA (Finite Element Analysis). The FEA highlights the stress levels in the product. This series of images show the stresses at the brackets and back to the structure when a static load is applied. It is worth considering that the dynamic load only applies an instantaneous load.

The stress levels highlight the intensity of the stress they do NOT indicate failure, they indicate where failure may occur when more force is applied.

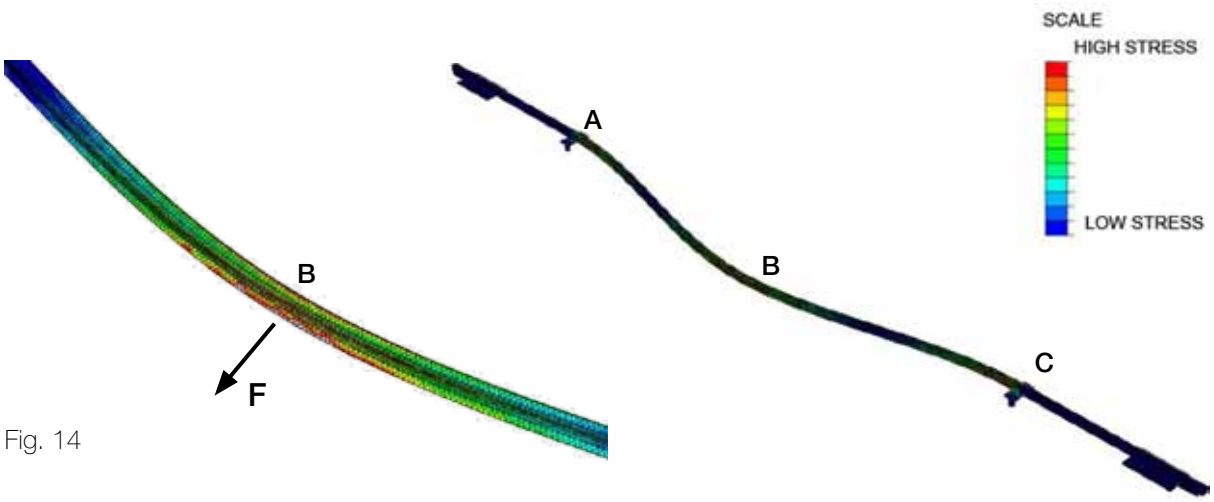


Fig. 14

Fig14 shows a maximum deformation of 0.28m (11") at 6kN (1350lbf). The side fix brackets are shown at points A and C. The force is applied at point B

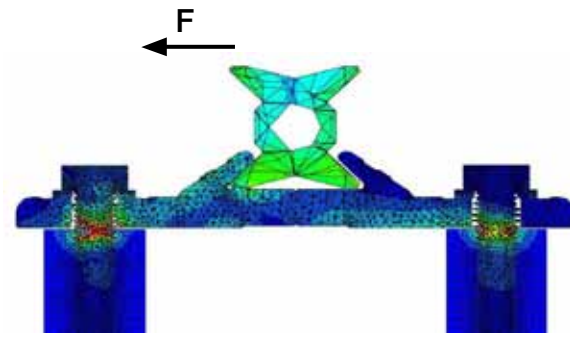


Fig. 15

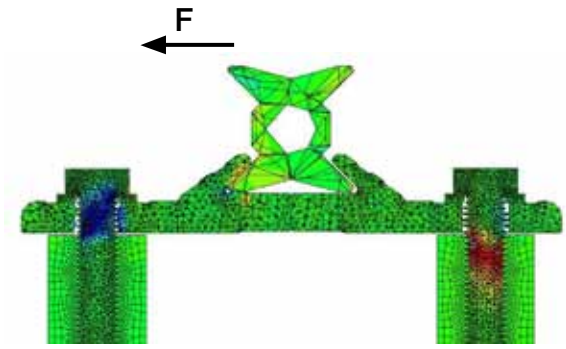


Fig. 16

Fig15 shows a cross section through the intermediate side fix supports at A. The load set is the same as in fig 14. The Von Mises forces show the internal stress from the downward shear load which is acting on the bracket. The stress level is slightly higher on the bottom fastener (fastener on the left) as it has a larger contact zone than the fastener on the right.

Fig16 highlights the stress distribution as a tensile load. Note the higher stress seen in the top fastener (fastener on the right) as the overturning moment attempts to pull the fastener from its socket.

STRESSES ON THE CARRIAGE AT 6KN

These FEA (Finite Element Analysis) plots shows the stress levels on the carriage at a load of 6kN (1350lbf). Refer to the key for a scale.

The most noticeable point is the comparative stress level in the rail relative to the stress on the carriage. The stress distribution shows the rail is bending with an axial tensile force. The load applied to the rail by the carriage is mid span, between side fix supports at 3m (9' 9.6") centres. The rail is undergoing simple bending therefore the tensile and compressive forces are of similar magnitude.

In the carriage the high stress level is again found at the local area of load transfer from one component to another (Fig19). The constraint holding the wheel to the rail and in turn the shackle shows a high level of stress.

This stress concentration will reduce when the contact area increases due to elastic and plastic deformation of the components.

This confirms the physical test data gathered by Uniline on this system.

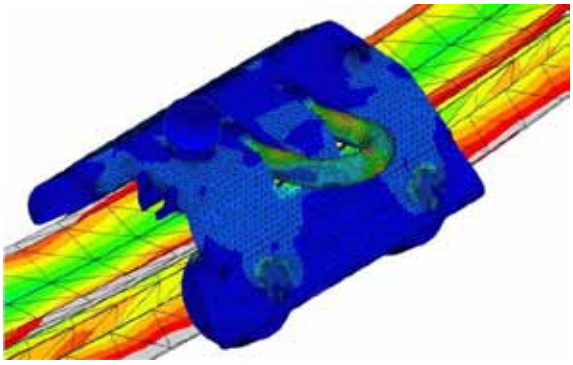


Fig. 17

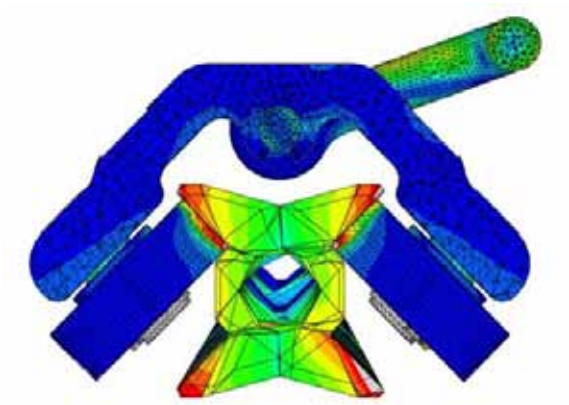


Fig. 18

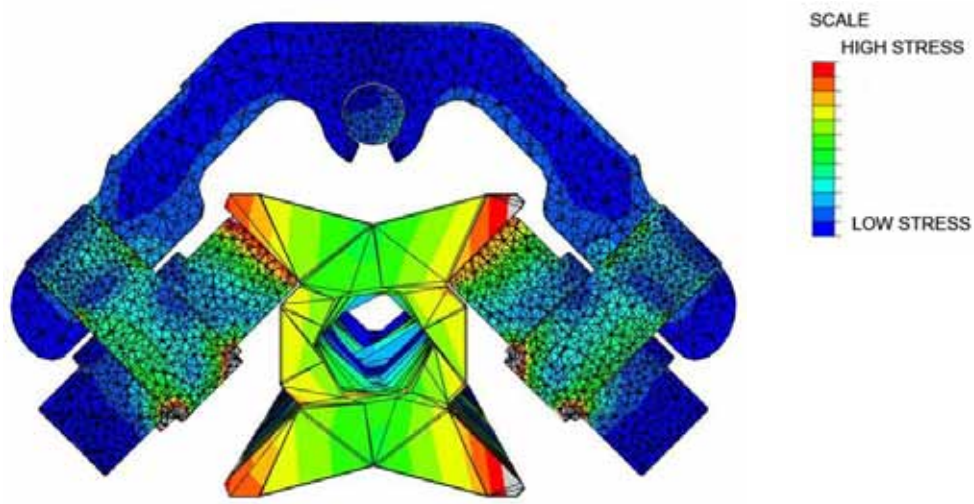


Fig. 19

SUSPENDED ACCESS

UniRail is often used for suspended access (work positioning). When the rail is fitted in for this application the intermediate bracket spacing needs to be reduced from a maximum of 3m to 0.52m (1' 8.4"). The reason for this is to keep the rail deflection to a minimum. The deflection in Fig 22 has been amplified 100 times for illustration purposes. The rail deflects 0.5mm (0.02") when 1kN (225lbf) (approx 1 user) is applied mid span between brackets at 0.52m (1' 8.4") centres. The deflection for 2 users (1kN (225lbf) per user) is 0.6mm (0.024"). Fig 20 shows the stress levels in the rail, see the key for a scale of the stress. Higher levels of stress are seen in the extreme fibres of the rail. Fig 21 shows a section through the bracket at position A, The higher levels of stress are focused around the contact between the head of the fastener and the concealed fix bracket.

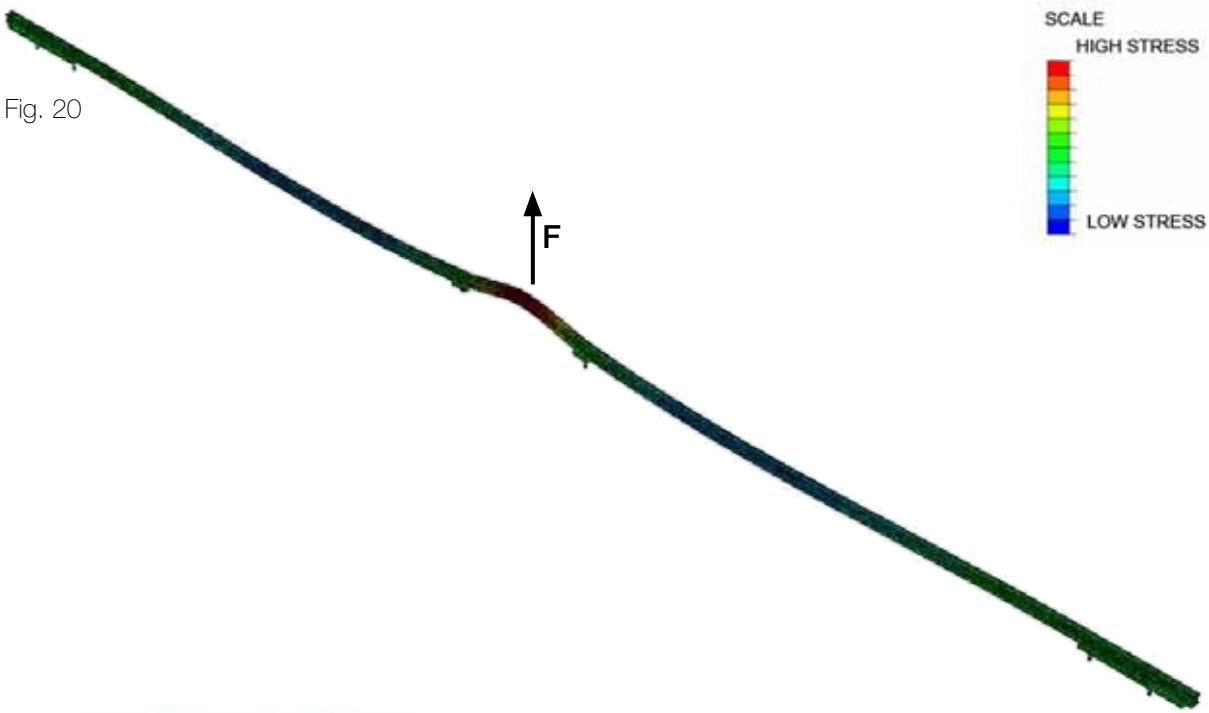


Fig. 20

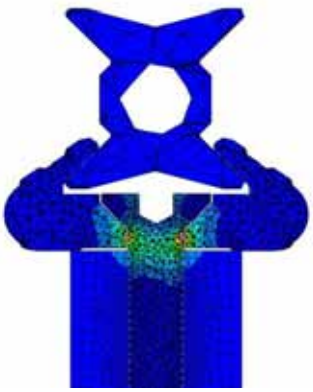


Fig. 21

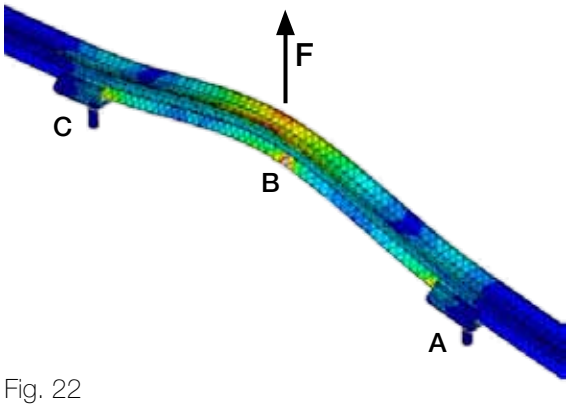


Fig. 22

4.4 Engineer's Reference Table

6000 Series aluminium alloy Rail Section	Metric	Imperial (US)
Density	2.70 g/cc	0.0975 lb/in³
0.2% Proof Stress	255 MPa (minimum)	16.5 tonne / in^2
Ultimate Tensile Strength	295 MPa (minimum)	19.1 tonne / in^2
Elongation	10 % Minimum	10 % Minimum
Coefficient of Thermal Expansion for Aluminium	23 x 10^{-6} m/°C	12.3 x 10^{-6} in/°F
Cross Section Area	499.11mm^2	0.774 in^2
Moment of Inertia	IXX = 51847mm^4 Iyy = 30384mm^4	0.125 in^4 0.073 in^4
Section Modulus	Z xx=3266mm^3 Z yy=1908mm^3	0.199 in^3 0.116 in^3
Radius of Gyration	Rxx = 10.192mm Ryy= 7.789mm	0.401 in 0.307 in
Elastic Modulus	70GPa	1.46x10^9 lb/f^2
Poisson Ratio	0.35	0.35

4.5 Specifying Anchors

There are a wide range of structural anchors available for fixing into a number of different materials and structures.
UniRail is a versatile product. It has been fitted to churches, water treatment tanks, cranes, boats and wind turbines. Each structure offers a new fixing challenge.

When selecting an anchor you must consider the following criteria:

- The strength of the structural base
- The age and condition of the structural base
- Additional surface finishes (screed or fascias)
- Surface finishes (Galvanising, Paint etc)
- Galvanic Corrosion
- Shock Loading Capability
- Edge Distances
- The Tensile & Shear Loads from the UniRail System

- The Environmental conditions such as;

    - Temperature Range
    - Chemical Exposure
    - Radiation
    - Saline Concentration
    - Humidity
    - Exposure to Vibration

Uniline have selected some suitable mechanical and resin anchors from Hilti which are detailed in the Installation Instructions.

4.6 Typical Considerations When Specifying a System

ENVIRONMENT

Due consideration should be given to any localised environmental factors that may affect the performance of the system or the requirements for inspection. Factors may include, but are not limited to: extremes of temperature, exposure to chemicals or fumes which may cause or accelerate corrosion, possibility of vibration or impacts from other equipment, ...

ORIENTATION

It is recommended that UniRail is mounted in either an overhead or wall mounted orientation, where possible. If this is not possible, then it may be floor mounted.
It is important to take into consideration fall factors, the type of work is being carried out and where the worker needs to be positioned to carry out the work safely. The Rail should be mounted in an orientation that gives the best possible protection without hindering the users ability to work.

INSPECTION REQUIREMENTS

The frequency and type of inspection required can affect the specification of the system. For example: In very exposed environments, or where there is the potential for untrained access to parts of the system. It may be best to specify a concealed fix system where the fixings are less exposed, and can not be tampered with. If the system is going to be exposed to a high corrosive environment a side fix system may be more suitable as the fixings can easily be inspected and assessed for servicing.

Under normal conditions the system must be inspected every 12 months in accordance with Uniline's Maintenance Check Sheet. The inspection should be conducted by an approved Uniline installer. A system which will be used for suspended access should be inspected every 6 months or in accordance with local government regulations.

COST REQUIREMENTS

The cost of servicing and maintenance should be taken into the consideration as well as the initial cost of the system. The cost of installation should also be considered, if the system is being installed in an orientation or location which is very hard to access then the time and cost of the installation will increase.

STRENGTH OF THE SUPPORTING STRUCTURE

The strength of the supporting structure needs to be assessed by a structural engineer before the system is installed, it is important that the strength and the number of fixings used are strong enough to support the loads transferred back to the structure.

FIXINGS

Fixings must be suitable for the type of structure being attached to. Through fixings may be more suitable for sheet materials such as structural steel work. For brickwork, or concrete Uniline recommends Hilti Mechanical fasteners. (see section 4.4 of this guide and the installation instructions for more information). A suitable factor of safety must be taken into account when specifying the type and strength of fixings, this is especially important where the system is exposed to extremes of environmental conditions.

UNQUALIFIED ACCESS

Although only fully trained personnel should use and have access to the system, sometimes there is the possibility for untrained contractors or personnel to gain access to area of the system, particularly if the building is multi-occupancy, or open to the public. This is most likely to occur at entry and access points where there are other safe means of accessing the area. In these cases it may be suitable to make sure that the users are made aware of how to look for signs of damage before they attach to the system, or a more frequent inspection regime may be required.

5. Personal Protective Equipment

All Personal Protective Equipment (PPE) used in conjunction with the UniRail system should carry the following markings:

- CE mark or appropriate national certification.
- Date of manufacture.
- Standard that it has been manufactured to.

Any harness to be used should be a full body harness. Only dorsal attachment points are suitable for fall arrest and fall restraint. All lanyards used must have an energy/ shock absorbers.

Slings to be used with the system or as part of a work access provision, must be suitable for use as Personal Protective Equipment. Only slings made from man made fibres such as Polyamide or Polyester webbing are suitable for this application, and must have a minimum breaking strength of 22kN (4945.8 lbf).

Slings ropes and lanyards should never be connected directly to each other as movement can cause excessive wear, a suitable connector such as a locking Karabiner should be used.

Where the UniRail system is mounted in an overhead orientation, when a rope and grab or fall arrest block is being used, the fall hazard should be at an angle of no more than 20° either side of the system. This is to prevent hazardous swing-fall situations.

Only Personal Protective Equipment recommended or certified for use by Uniline with this specific type of system should be specified and used in conjunction with the UniRail product.
The use of un-certified or inappropriate PPE can lead to dangerous fall situations which may result in serious injury or in extreme cases death.

Users should always receive appropriate training when using any Personal Protective Equipment. It is essential to make sure that users a trained by a competent person before using the UniRail system and any associated equipment.

6. System Maintenance & Inspection

The following instructions cover the servicing procedures for the UniRail Concealed Fix and Side Fix System. They exclude the servicing requirements for anchors and Personal Protective Equipment such as harnesses, energy-absorbing lanyards and connectors.

The table below sets out occasions when servicing may be required and the type and content of service needed.	Type of servicing required
Routine reasons (e.g. annual service under BS EN 365)	A
Customer request (unscheduled)	A
A defect or damage has arisen in use	B
The system has sustained a fall arrest loading	C

TYPE "A" SERVICING

A.1 Removal of the Carriage from System

In installations which have the tamper proof end stops or are of the closed loop type, the carriage remains mounted to the rail at all times. Gain access to the UniRail System using a spare carriage or a separate means of fall protection if necessary. Remove the carriages from the system by removing the screws securing the tamper proof end stops, or the rail gates, as appropriate.

A.2 Cleaning

If any part or component of the system needs cleaning prior to examination, proceed as follows:

- Carriage: To clean, immerse the carriage in a mix of hot water / mild detergent. The carriage can then be rinsed and dried using a clean non-abrasive cloth. Solvents and acidic based products must not be used for cleaning.

- Rail: The carriage cleaning procedure can also be used to clean the rail. A fibre brush can be used to remove dirt, etc. Never use wire brushes and never use solvents.

A.3 Examination of the Carriage

- Ensure that the connection between the energy-absorbing lanyard and the carriage shackle is sound and that the webbing and stitching is unchanged.

- Ensure that the carriage shackle is free to pivot and that it's securing pin is centrally locked on the inside face.

- Ensure that the four wheels are in place, undamaged and are able to rotate. Check that each has it's securing clip in place and that the wheel axel is not loose.

- Ensure that the knurled knob is unscrewed sufficiently to prevent a restriction on the rail. Check that the securing clip is in place.

- Check the carriage for obvious damage, such as cracks, heavy indentations or severe corrosion. Remove and dirt from the inside face and bearing wheels. Reject the carriage is it appears unserviceable.

- If the shackle requires lubrication, apply a light water repellent lubricant sparingly; avoid contact with the carriage wheels, lanyard and harness. Do not use any type of lubricant on the carriage wheels.

A.4 Preparation to the Examine Remainder of System

Depending upon the type of system, examine the tamper proof stops/plunger stops for obvious defects such as cracks or heavy corrosion.

- Tamper Proof Stop: Hold the tamper proof stop and give it a sharp tug to ensure that it is secure. Also check with a torque wrench that it is tightened to 15Nm

- Plunger Stop: On the plunger stop ensure that the plunger operates satisfactorily. reject defective articles.

Put on the safety harness to be used with the system in accordance with the manufacturers' instructions. Connect one of the energy absorbing lanyards to the attachment point of the harness and the other to the carriage.

A.5 Examination of Remainder of System

Walk along the UniRail System and ensure that the carriage glides along the rail without being impeded. Check that the system components are not defective. Ensure that all joints are complete with fittings intact. In particular:

- Rail: Check for any obvious damage such as cracks, heavy indentations, deformation or severe corrosion. Deformation and indentations may be evidence of a fall.

- Check for chemical contamination (e.g. discolouration) and heat damage (e.g. weld splatters). Particular attention should be paid to joints.

- Ensure that the other system stop is firmly in place and that they prevent the carriage from coming off the rail unintentionally. Check that the moulded rail end covers are not missing or split.

- Check the security of the rail at regular intervals by giving it a sharp tug. Look for external damage to the supporting structure, e.g. cracks in masonry.

- Check all fasteners which anchor the rail to the structure for obvious damage and ensure with a torque wrench that they are torqued to their required settings. Also check the fasteners which join the rail sections together. If a structural fastener is in question then a tensile pull test with a Hydrajaws pull tester must be conducted on the anchor.
  NOTE: Never use the carriage as a means of applying the load to the rail/bracket.

Any defective parts should be marked and replaced as necessary. Refer to TYPE "B" Service instructions for replacing rail components. Record that the servicing has been carried out on the inspection/servicing sheet.

IMPORTANT NOTE:
IF IT IS SUSPECTED THAT A FALL ARREST
HAS OCCURRED, CARRY OUT A TYPE "C" SERVICE

TYPE "B" SERVICING

Once the defect has been identified it must be assessed against the rejection criteria under the Type "A" Service. Replace defective carriages as necessary. Replace rail sections/ components in accordance with the instructions below.

B.1 Replacing Rail Sections and Components (Concealed Fix System – End Rail)

See also B.5 and B.6. Undo the M10 joint screws and disengage the joint body. Remove the rail section by sliding it through the end and intermediate anchors.
Replace defective anchorages and anchor bolts as necessary. Fit the new rail section in accordance with the UniRail installation instructions.

B.2 Replacing Rail Sections and Components (Concealed Fix System–Intermediate Rail)

See also B.5 and B.6. Undo the M10 joint screws and disengage the joint bodies on either side of the rail being replaced. Cut out a section of rail between a pair of intermediate anchors using a circular saw to ensure a clean cut. Remove the remainder of the rail by sliding it through the intermediate anchors.
Replace defective anchors and anchor bolts as necessary. Fit the new rail section in accordance with the UniRail installation instructions.

WARNING !
THE FOLLOWING PROCEDURES ARE FOR REPLACING
DAMAGED OR DEFECTIVE COMPONENTS FOLLOWING NOTIFICATION THAT THE
SYSTEM IS UNSERVICEABLE.
DO NOT ATTACH TO THE UNIRAIL SYSTEM
UNDER THESE CIRCUMSTANCES.
USE A SEPARATE SAFE MEANS OF FALL-PROTECTION

B.3 Replacing Rail Sections and Components (Side Fix System End Rail)

See also B.5 and B.6. Undo the M10 joint screws and disengage the joint body. Remove the rail section by sliding it through the end and intermediate anchor spacers.
Replace defective spacers and anchor bolts as necessary. Fit the new rail section in accordance with the UniRail installation instructions.

B.4 Replacing Rail Sections and Components (Side Fix Systems – Intermediate Rail)

See also B.5 and B.6. Undo the M10 joint screws and disengage the joint body on either side of the rail being replaced.
Undo the intermediate anchor bolts and remove the rail.
Replace defective anchors and anchor bolts as necessary. Fit the new rail section in accordance with the UniRail installation instructions.

B.5 Impact Damage to Rail by a Falling Object (Not a Fall Arrest Loading)

Where the UniRail System has been damaged by a falling object, (not a loading produced by a fall arrest incident), in addition to the defective rail section(s) being replaced, the anchors which support the damaged section(s) and the anchors which support the two adjacent sections* need to be removed, examined and retested. Defective items are to be rejected.
*That is each adjacent fully serviceable section either side of the defective section or sections.

B.6 Damage to Rail by Chemical Substance or Fire

Specialist advice must be sought before proceeding with anchor work to ascertain whether or not the chemical substance or fire has weakened the structural fabric. Once it has been determined that the structural fabric is in a satisfactory condition, anchor work can proceed. In addition to the defective rail section(s) being replaced, the anchors which support the damaged rail section(s) and the anchors which support the two adjacent rail sections* need to be replaced. The existing anchors and socket holes should not be used; these should be plugged.
*That is each adjacent fully serviceable section either side of the defective section or sections.

B.7 System Checks

After rectifying the defect, the whole system is to be checked in accordance with the Type “A” Service, as there may be other defects unrelated to the incident. Record that the servicing has been carried out on the inspection/servicing sheet.

TYPE "C" SERVICING

Ascertain on which part of the system the fall took place. Depending upon the severity of the fall this should be identifiable by markings on the rail section or by deformation. The persons involved in the incident should also be able to give an indication.

The following actions are to be carried out on the component below:	Action
Carriage(s), Lanyard(s), Harness(es)	Dispose of and replace with new items
Workplace structure to which UniRail System is attached	A specialist is to be called in to ascertain whether or not the structural fabric has been weakened as a result of the forces generated during the fall. Once it has been determined that the structural fabric is in a satisfactory condition, anchor work can proceed.
Rail and Attaching Components	Replace the section on which the fall took place and the two adjacent sections* flanking the fall section. If the fall occurred on a joint replace the joint and the two adjacent sections* flanking the joint. *That is each adjacent fully serviceable section either side of the fall section.
Anchors	Replace all the anchor bolts that correspond to the replaced rail sections. The existing anchor socket holes should not be used; these should be plugged.
Attaching Components	Replace all attaching components and joints

All replacement work is to be carried out in accordance with servicing section B.1-B.4 above. After carrying out all rectifying actions, the whole system is to be checked in accordance with the Type "A" Service, as there may be other defects unrelated to the incident. Record that the servicing has been carried out on the inspection/servicing sheet.

ANY DOUBTS WHICH EXIST REGARDING THE DESIGN, INSTALLATION AND/OR SERVICING OF THE UNIRAIL SYSTEM SHOULD BE DISCUSSED WITH UNILINE BEFORE COMMENCING WORK.

DO NOT PROCEED WITH AN INSTALLATION IF YOU ARE AT ALL UNCERTAIN.

UNILINE SAFETY SYSTEMS LTD
TECHNICAL SUPPORT

7. Reference Documents

7.1 Abbreviations and Definitions

The following is a list of terms and their meanings as used in this publication (Further standards are listed in section 7.2 of this guide):

BS EN 795 The European Standard for protection against falls from a height concerning anchor device requirements and testing

BS EN 354 The European Standard for protection against falls from a height concerning lanyards

BS EN 355 The European Standard for protection against falls from a height concerning energy absorbers

BS EN 361 The European Standard for protection against falls from a height concerning full body harnesses

BS EN 362 The European Standard for protection against falls from a height concerning connectors

BS EN 363 The European Standard for protection against falls from a height concerning fall arrest systems

BS EN 365 The European Standard for protection against falls from a height concerning instructions for use and markings

BS 7883 Code of Practice for the application and use of anchor devices conforming to BS EN 795

89/686/EEC EC Directive relating to Personal Protective Equipment design and test

SI 3139 Statutory Instrument 3139 The Personal Protective Equipment (EC Directive) Regulations 1992 - the transposition of 89/686/EEC into UK National Law

7.2 Standards Table

European Standards	Standards Description	Synopsis	Test Data Available * /Documents
EN 795:1996	Protection against falls from a height- anchor devices- requirements and testing	Class D: Comprises anchor device employing horizontal rigid anchor rails	ESEN795/02/002 Cert:AD035 ESEN795/97/003 Cert:MNTG BSEN795/02/001 Cert:AD034 Cert:MQRY
US Standards			
OSHA 1926.502M (d) (15) (i)	Fall protection systems criteria and practices.	(a) "General." This appendix serves as a non-mandatory guideline to assist employers comply with the requirements in 1926.502(d). Paragraphs (b), (c), (d) and (e) of this Appendix describe test procedures which may be used to determine compliance with the requirements in 1926.502 (d)(16). As noted in Appendix D of this subpart, the test methods listed here in Appendix C can also be used to assist employers comply with the requirements in 1926.502(e) (3) and (4) for positioning device systems.	Declaration of Conformity
Australian/ New Zealand Standards			
AS/NZS 1891.2.2001	Industrial fall-arrest systems and devices Part 2: Horizontal lifeline and rail systems AS/NZS	This Standard specifies design and performance requirements for systems and associated component hardware for horizontal lifelines and rails used for fall-arrest purposes. The Standard covers systems using either rigid rails or flexible lines.	Declaration of Conformity
AS/NZS 1891.4.2000	Industrial fall-arrest systems and devices Part 4: Selection, use and maintenance	This Standard specifies requirements and sets out recommendations for the selection, safe use and maintenance of industrial fall-arrest systems and devices based on the use of safety harnesses (including belts), horizontal life lines and rails, fall-arrest devices, and associated lanyards, connectors, anchorages and fittings...	Declaration of Conformity

* If copies of the test certificates are required please contact Uniline Safety and quote certificate number.

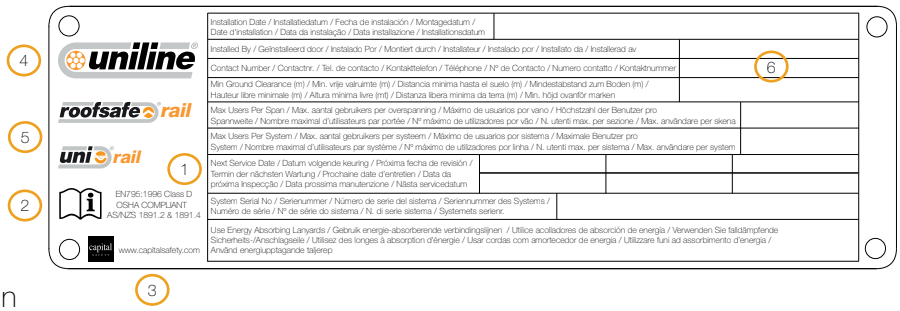
7.3 Markings Explained

Carriage Sticker

1. Standards to which the system conforms; EN 795: 1996 Class D, OSHA Compliant and AS/NZS1891.2
   Protection against falls from a height-Anchor devices.
2. Read Instruction for use
3. Part code and description
4. Web Address
5. Corporate logo

System Tag

1. Standards to which system conforms.
2. Read Instructions for use
3. Web Address
4. Corporate logo
5. Brand Family
6. System information to be filled in by installer



Component Marks

1. Each Component of UniRail is marked with a batch number to enable traceability of parts

Capital Safety Group, through our Uniline brand is the global market leader in the design and manufacture of engineered fall protection systems. Through a combination of expert knowledge and practical experience, we can help our customers reduce risk and increase safety when working at height.

Our comprehensive Uniline range of products offers fully compliant, practical solutions for structures of all types, in all industries. Our ethos of delivering quality, service, training and support for our customers has earned Uniline a deserved reputation for excellence around the world.

Operating through specialist safety companies globally, Uniline provides local support and installation services to meet the specific safety objectives of all our customers.

roofing systems™

If you need a safety solution for roof access during maintenance and inspection tasks, then look no further than Uniline's Roofing product range. Our products, including roof anchors, horizontal lifelines & horizontal rail systems offer comprehensive protection for workers on all types of roofs.

horizontal systems™

The products in our Horizontal systems range are some of the best know brands in fall protection safety. The versatility of these products combined with Uniline's expertise in fall protection ensures we can solve even the most complex of height safety problems in industry, construction, façade access and for all manner of building maintenance and inspection tasks.

vertical systems™

The best vertical fall protection systems in the world won't let you down. The extensive development of this range of products for vertical structures including masts, towers, pylons, wind turbines, silos, bridges and chimney stacks ensures customers will enjoy the safest and most functional climbing experience possible.

access systems™

A unique range of custom access products for challenging fall protection situations in transport and industry. These solutions are structurally analysed and designed to our customers exact needs and specifications.

local distributor/systems integrator

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