Fall Arrest Systems (Safety Lines)

Document no.	Work description
SMS-06-SW-0259	Design, installation and use of safety line systems for working at heights.
	Scope Covers all types of safety line systems, including static, flexible, vertical, horizontal, permanent and temporary safety lines.
Review date	**References** • OHS Reg 2001 • WorkCover Code of Practice for Safety Line Systems • AS/NZS 1891 - Industrial fall arrest systems and devices (all parts) • SMS-06-GD-0240 Working at Heights • SMS-06-SW-0241 Fall Arrest Systems • SMS-06-SW-0256 Fall Arrest Systems (Harnesses, Lanyards and Attachment Hardware) • SMS-06-SW-0254 Fall Arrest Systems (Anchorages)

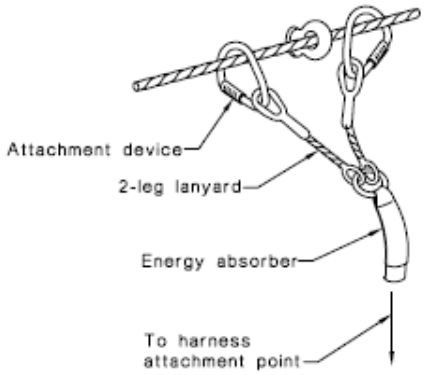
Responsible supervisor	PPE and precautions	Competencies or qualifications	Licences or permits required
	• Full body fall arrest harness • High vis vest where required • Helmet with chin strap, where helmet is required • Non-slip footwear	Safety lines are to be installed by a person holding a WorkCover Certificate of Competency in either Basic Rigging or Basic Scaffolding.	N/A

Tools and equipment required

Safety lines, anchorage points, lanyards, turnbuckles, eye and thimble

IF CONTROL MEASURES ARE NOT SUITABLE AND MAJOR CHANGES ARE NEEDED, CONDUCT A RISK ASSESSMENT AND DEVELOP NEW CONTROLS ACCORDING TO SMS-06-PR-0104 WORKPLACE RISK MANAGEMENT.

Engineered and manufactured systems	These systems are to be designed for the potential load on the system, taking into consideration: • the number of persons on the line at any given time • whether energy absorbing lanyards are to be used. Information provided to the system installer or user is to include details of: • the number of persons that can be on the line at any one time • whether or not energy absorbing lanyards are required • any other restrictions on the use of the system.

Installation	Safety lines are to be installed by a person holding a WorkCover Certificate of Competency in either Basic Rigging or Basic Scaffolding. If a system is not provided with purpose-designed connections, eg. a prescribed configuration system, connection to the system is to be by means of attachment hardware such as snap hooks or karabiners. Intermediate anchorage points are to be able to be crossed without the user disconnecting from the system, either by using two separate lanyards, or a dual attachment lanyard. Take care to make sure the energy absorber is not 'short-circuited', i.e. by clipping one leg of the dual lanyard back to the harness.	 **Figure 1 Safety line installation**

Termination hardware	All termination hardware including turnbuckles is to be effectively locked or otherwise secured from inadvertent opening.

System information plate

A system information plate is to be displayed at each regular entry point to any permanently installed horizontal lifeline or rail system. The plate is to provide the following information:

- the manufacturer's and installer's name and the installation date
- a unique identification number
- an instruction that a personal energy absorber or a fall-arrest device with energy absorbing properties is to be used
- any special instructions for use, including the number of users allowed on the system or on any one span at once
- servicing requirements and instructions, together with inspection and servicing intervals and the dates on which they are to be carried out
- the month and year by which the system is to be taken out of service (unless it has been re-certified by a competent person in accordance with the manufacturer's instruction as safe for continued use). This date is not to be not more than 10 years from the date of the original installation or more than 5 years from any subsequent re-certification.

The plate is to be made from tamper resistant material and installed so it retains the information in legible condition for the expected life of the installation.

Line tensioners

Line tensioners are to be used to tension the line and achieve the predicted performance of the system under fall-arrest. Line tensioners can range from simple turnbuckle type devices, to more complex types offering a tension measurement, or they may be combined with an energy absorber.

Warning
Over-tensioning of the line can result in increased load in the end anchorages, or in the extreme failure of the system in the event of a fall.

The line tension is to be within limits set by the supplier or designer. This may be given as:

- a torque or other load reading on a tensioning device
- a special tensioning tool that limits the tension which can be applied
- a defined sag at the mid-point of a nominated span.

End anchorages for horizontal lifelines

End anchorages of the required strength in the required directions are to be provided.

The anchorage strength is usually much greater than the 15kN required for single point anchorages.

The general requirements for anchorages set out in Fall Arrest Systems (Anchorages) SWI also apply in this case. However, the anchorage strength is to be as set out either in manufacturer's instructions or in the tables included in Supplement 1 of AS1891.2.

Intermediate anchorages for horizontal lifelines

An anchorage and a corresponding support on the structure, capable of sustaining a vertical force of 12 kN is required where the line is straight through the intermediate anchor, or is diverted horizontally not more than 15^0.

If the horizontal diversion is greater than 15^0 the resultant of the maximum fall arrest forces in the line on each side of the anchorage is to be calculated, and a safety factor of 2.0 is also to be provided for this horizontal loading.

The horizontal and vertical loadings are to be provided for independently of one another.

Provision is to be made for personnel to approach and connect onto a horizontal lifeline or rail system.

Personnel are not to be exposed to a fall-risk situation, or are to be protected by means of another fall-arrest system which allows them to transfer to or from the line or rail and always remain connected to one system or the other. The approach can comprise, for example, a fully protected walkway or a ladder equipped with a ladder fall arrest system.

Single span specifications

A system need not be designed for a single span if:

- it spans only 4 to 6 metres
- no more than 2 people are on the line at any one time
- all personnel are using lanyards with energy absorbers rated at 6kN or less.

In this case, the following specification is to be used:

- cable – 10mm diameter (minimum) flexible steel wire rope
- sag – approximately 50mm per meter, i.e. 6m span = 300mm sag
- anchorage – capable of supporting an imposed load of 40kN
- tensioning turnbuckles – 1 tonne (minimum) working load limit (WLL).

Multiple-span specification

The specification for a multi-span system is the same as that for a single span system with the following exceptions:

- sag for 2 to 3 continuous spans - approximately 30mm per meter i.e. 6m spans = 180mm sag
- sag for 4 or more spans - no minimum sag required but line should not be over tensioned.

Where a line is not free to slide through a corner support or intermediate support of a multiple span, the support is to be regarded as an end anchorage and is to be capable of supporting an imposed load of 40 kN.

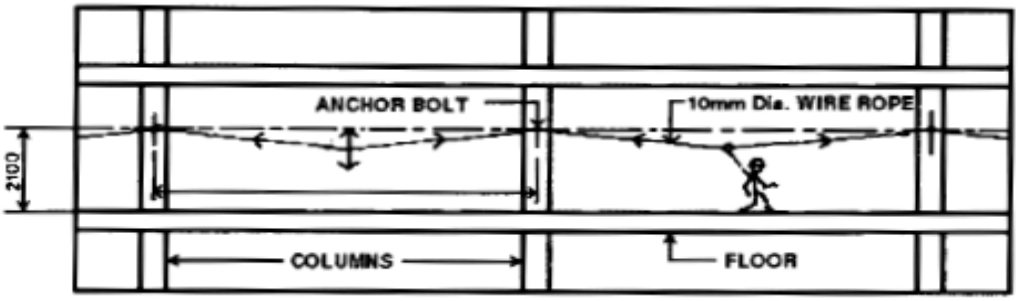


Figure 2 Multiple span specification

Static line spans

Bulldog grips are not be used on any static line.

The line is to be supported at each column, or in accordance with an Engineer's specifications.

The line is to be placed to eliminate the risk of tripping. Where practicable the line is to be located no less than 2.1m above the floor of the work area. The point of attachment to the safety line system is to be reachable by the user standing on the floor. See Figure 3.

Anchorages and line supports are to be positioned on the inside face of columns where practicable and are to be used to anchor static lines. The static line can pass through a cavity "tube" cast in concrete columns for that purpose.

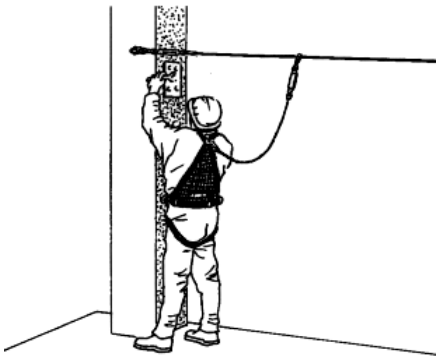


Figure 3 Static line span

Lines between supports are to be free of obstructions to allow uninterrupted movement for personnel attached to the line.

If a line passes around a column corner or other sharp edge it is to be suitably packed to prevent damage.

Tensioning is to be achieved by turn buckles or other appropriate means. Turnbuckles are to be used as described:

- if ratchet and pawl devices are used for tensioning, they are to be removed from the system after the tensioning is completed
- lines can be joined by:
  - terminating each line end by using a thimble and three (3) evenly spaced double saddle wire rope clips and allowing a 200mm tail
  - using a shackle to join the lines together
- line joins are to be located at or adjacent to supports or anchorage points
- lapped joins of lines are not be used under any conditions.

Line systems for vertical travel

When using vertical lifelines (droplines) or other vertical fall arrest systems in connection with work from bosun's chair or ladders, only one person is to be attached to any one lifeline.

Vertical lifelines are to comply with AS1891 Part 3, Industrial Fall-arrest Systems and Devices.

Refer to Fall Arrest Systems (Anchorages) SWI for information about anchorage points for vertical lifelines.

Static line ends

The termination of a line is to be by means of an eye and thimble.

Where practicable, ends should be secured by one of the following:

- double saddle wire rope clips with a minimum of three (3), at equal spaces with a minimum 200 mm tail past the last clip
- a hand splice with thimble eye
- a machine splice with thimble eye
- suitable wedge sockets
- purpose designed fittings, e.g. swaged or pressed fittings.

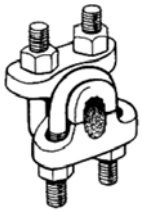


Figure 4 Static line end

Lines and fittings are to be secured directly to anchorage points with "D" or bow shackles of a minimum size of 12mm or having a capacity not less than 2 tonne.

The pin of the shackle is to be moused (lashed) to the shackle.

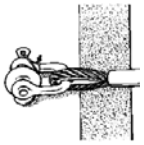


Figure 5 D or bow shackle

Installation of anchorage points

All bolts referred to in this SWI are to comply with AS2317 Collared Eye Bolts.

As it is safer to work below the point of anchorage, anchorage points used are to be located as high as equipment permits. Intermediate supports of static lines are not to exceed design specification.

The following types of anchorages are acceptable when used in concrete:

- cast-in anchors (in situ):
  - a wall tie (shee-bolt) purpose designed
  - an engineer designed anchorage
- chemical and friction type anchors.

Chemical or friction type anchorages are to be proof-tested in tension to at least one third of the design load before use. Collared eye bolts are to be used. All anchorages are to be visually checked before use.

Electrical safety

Electrical equipment used in the installation of anchorages is to comply with the NSW Code of Practice for Electrical Practices for Construction Work.

Turnbuckles

Turnbuckles are to comply with AS2319 Rigging Screws and Turnbuckles

Only "framed" turnbuckles of an open type design are to be used. This is to allow visual inspection of the condition and extension of the threaded sections.

The frame is to be locked or moused (lashed) to the eye bolt to prevent slackening due to vibration, shock or spin in the line attached.

Only eye or clevis type turnbuckles are to be used on line systems.

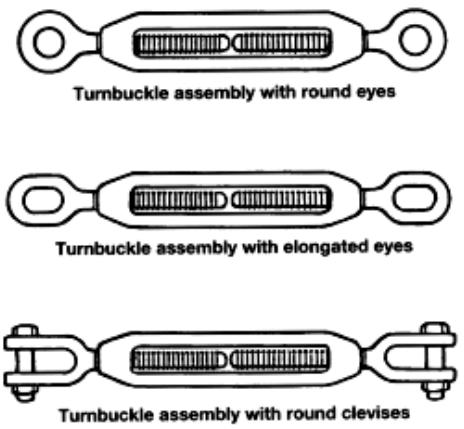


Figure 6 Turnbuckles

Horizontal lifeline system

Use of the prescribed configurations for a horizontal lifeline set out in this SWI is subject to the following:

- A fall arrest harness is to be used as specified in the Fall Arrest Systems (Harnesses, Lanyards and Attachment Hardware) SWI with:
  - a lanyard assembly (ie. including a personal energy absorber)
  - a fall-arrest device meeting the requirements for a Type 2 or 3 device must be worn or used by all personnel, strictly in accordance with manufacturer's instructions.

Note
The predicted performance of the system assumes that the fall-arrest force in the lanyard will not exceed 6kN.

Not all Type 2 or 3 fall-arrest devices are suitable for use with horizontal lifelines. If in doubt, check with the device manufacturer.

- The line is to run freely through intermediate supports.
- All personnel are to be able to pass an intermediate anchorage without completely disconnecting from the system. This is usually achieved by providing a second lanyard, or a dual attachment lanyard similar to that illustrated in Figure 1.
- The maximum overall length of the line is to be 100m, and of any one span 10m. The minimum overall length of the line and of individual spans is to be limited to the minimum configuration allowed in the tables given in Clause 6 of AS/NZS 1891.2 Supp1:2001.
- The number of personnel using the system at any one time is not to exceed four.
- The number of personnel using any one span at any one time is to be limited to either one or two, depending on the provision made as set out in “Provision of end anchorages for horizontal lifelines”.
- The line is to be limited to 8, 10 or 12mm diameter galvanized steel cable of 6 × 24 fibre core construction, Grade 1570 or 1770.
- The horizontal deviation of the line at any intermediate support (see Figure 7), is not to exceed 15^0.
- Line energy absorbers are not to be used.

Note
Predicted maximum system deflections under fall-arrest conditions are based on the assumption that line energy absorbers are not used.

- The line is to be rigged so that it is at least 1.5m above the working platform but preferably above the head height of the people attached to it, and located laterally so that, in the event of a fall, the fall-arrest force cannot act on the cable at an angle greater than 30^0 to the vertical, measured at right angles to the line as shown in Figure 8.
- The line is to be located so that, in the event of a fall remote from the centre of a span, the resulting longitudinal movement or swing during the fall will not bring the wearer into contact with an obstruction. In the case of long spans, special care must be taken.
- Attachment of lanyards or fall-arrest devices to the line is to be by means of snaphooks, karabiners or pulleys only. Snap hooks and karabiners are to meet the requirements for attachment hardware specified in the Fall Arrest Systems (Harnesses, Lanyards and Attachment Hardware) SWI.
- Pulleys, where used, are to meet the requirements specified in AS/NZS 1891.2 for purpose built mobile attachment devices.
- Lanyard lengths are to be selected to limit free fall to not more than 2m, as far as practicable.

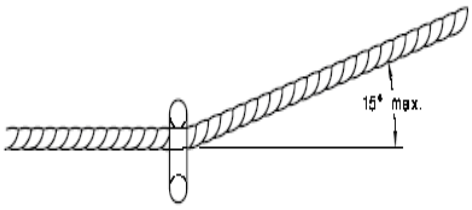


Figure 7 **Direction change at an intermediate anchorage**

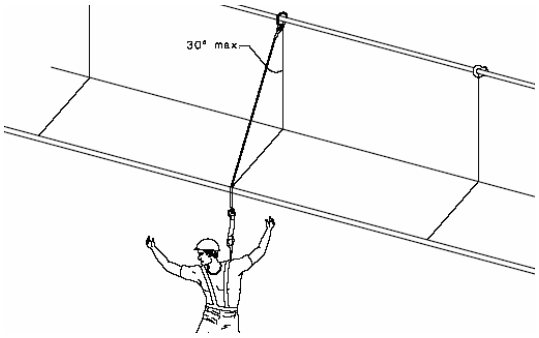


Figure 8 **Angular limit on direction of line loading**

Note
Snaphooks and karabiners are to be made from a material that is durable enough to resist wear from frequent travelling along the line.

Their surface finish must not damage the line or fittings.

Training	Before working at heights, RailCorp employees and contractors are to be properly trained in:
	• the method of working at heights to be used
	• an understanding of the particular task requirements and any hazards and risks involved
	• correct selection, fitting, use, care and storage of:
	  - fall prevention systems and arrest equipment
	  - personal protective equipment
	  - tools and equipment to be used
	• procedures in the event of an emergency such as rescue, accident or injury.
	Users of fall arrest systems and equipment are to be trained and assessed as competent before being allowed to work without direct supervision in accordance with training requirements defined in the Working at Heights guide.
	Line Managers are to make sure that employees are properly trained and possess the above competency.

Additional controls