PACI PROTOCOLS FOR ATTACHING CLIMBING ROPE TO PARTICIPANTS HARNESS (artificial climbing surfaces)

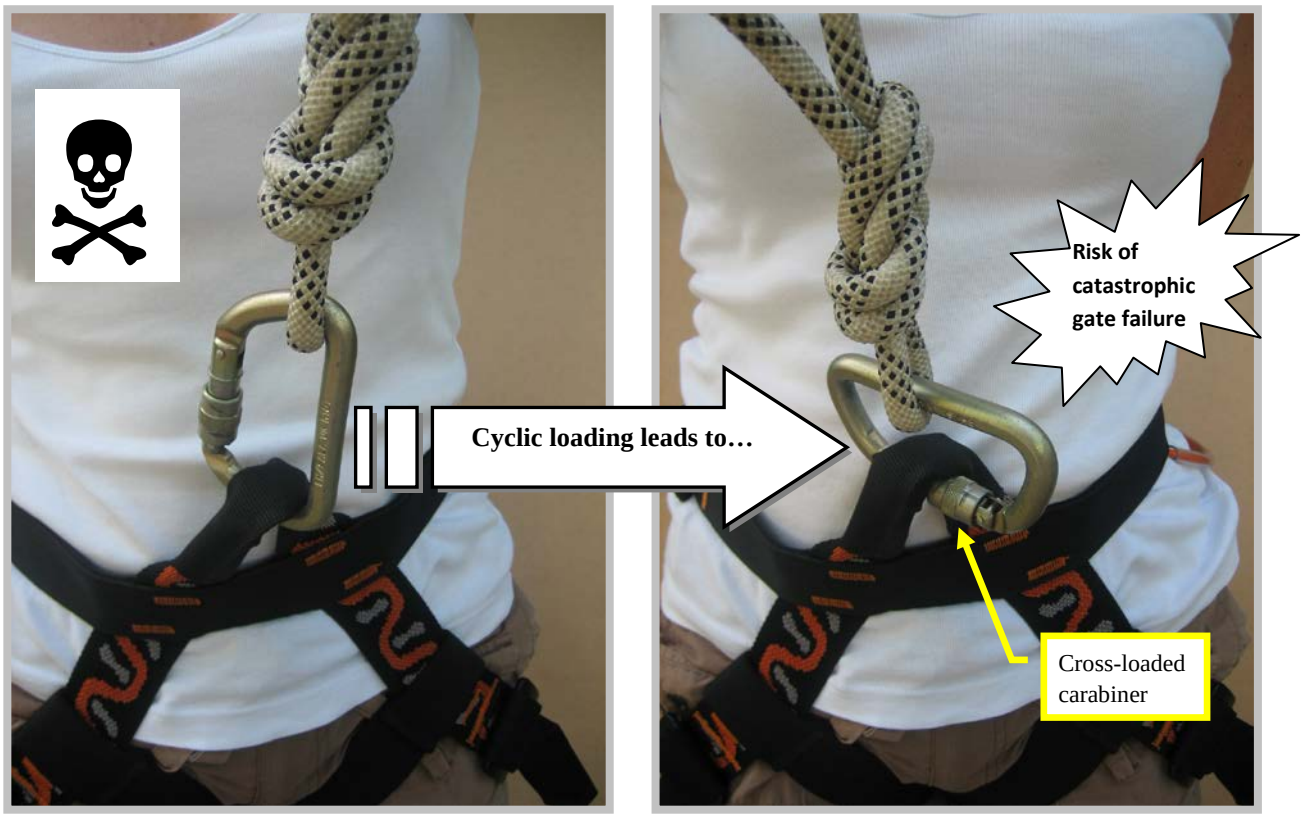
On 13 November 1996, 15 year old Jade Frances fell and became a paraplegic at an indoor climbing facility in NSW. The climbing facility pleaded guilty to a breach of section 47A of the NSW OHS Act and was fined $12,500 in the chief industrial magistrate's court of NSW. A conviction was recorded. The maximum possible penalty at the time was $50,000.

Case citation: Inspector Victor Page v. 4 in 1 Fitness Pty Ltd (14 April 2000) Matter No. 98/2356

None of this was any comfort to Jade as she would spend the rest of her life in a wheel chair. The root cause of the accident was inappropriate attachment of the climbing rope to her harness. The connection method was susceptible to accident disconnection. Surprisingly, the industry has not learnt from this tragedy as here have been several horrific accidents since that time.

This document seeks to warn the public and climbing facility operators of the risks associated with insecure rope attachment methods.

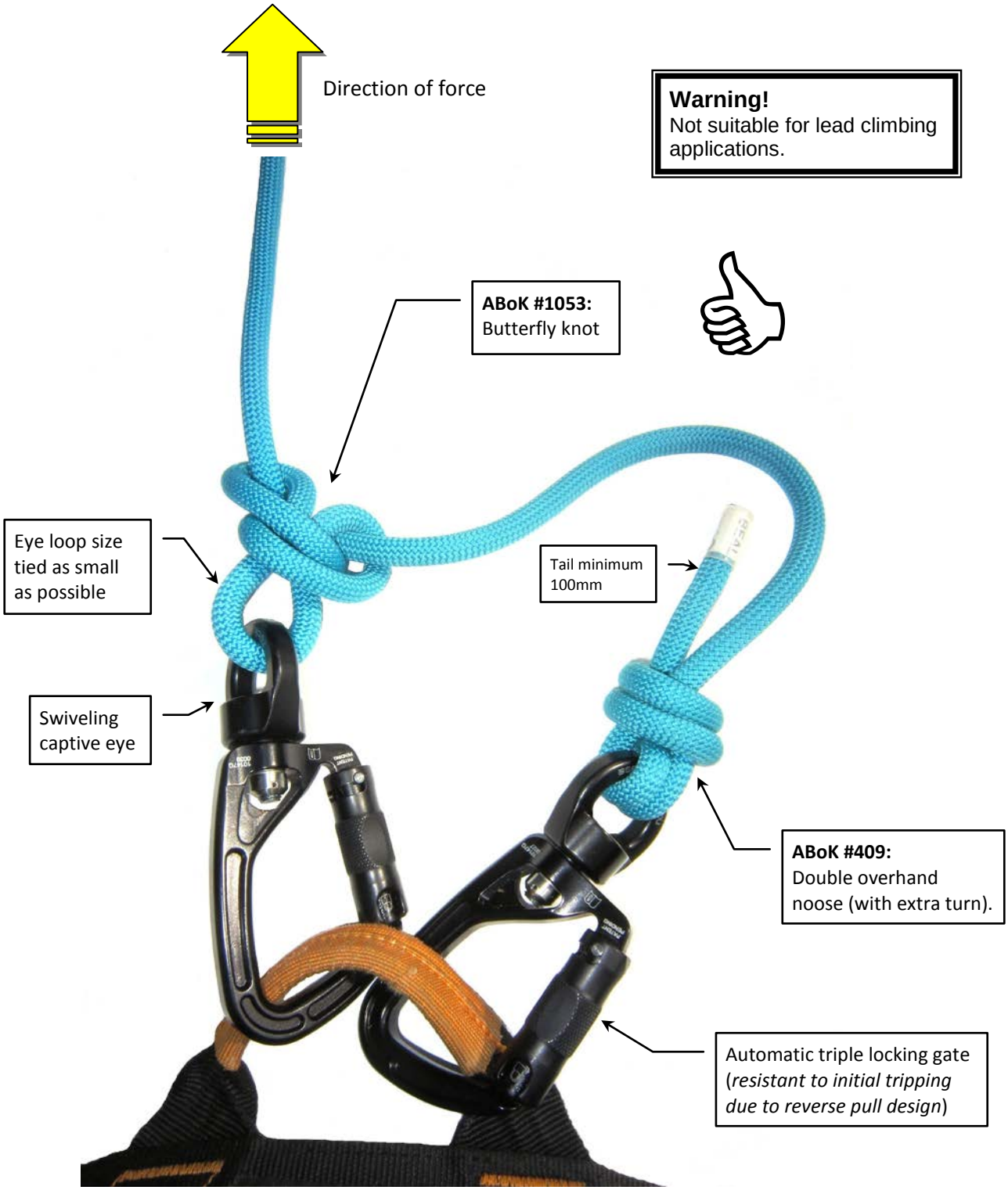
The failure mode is illustrated below:



This type of rope attachment method is expressly forbidden by PACI. Climbing facility operators who continue to use this type of attachment method are guilty of gross negligence and under today's legal climate, could be convicted of manslaughter with risk of imprisonment.

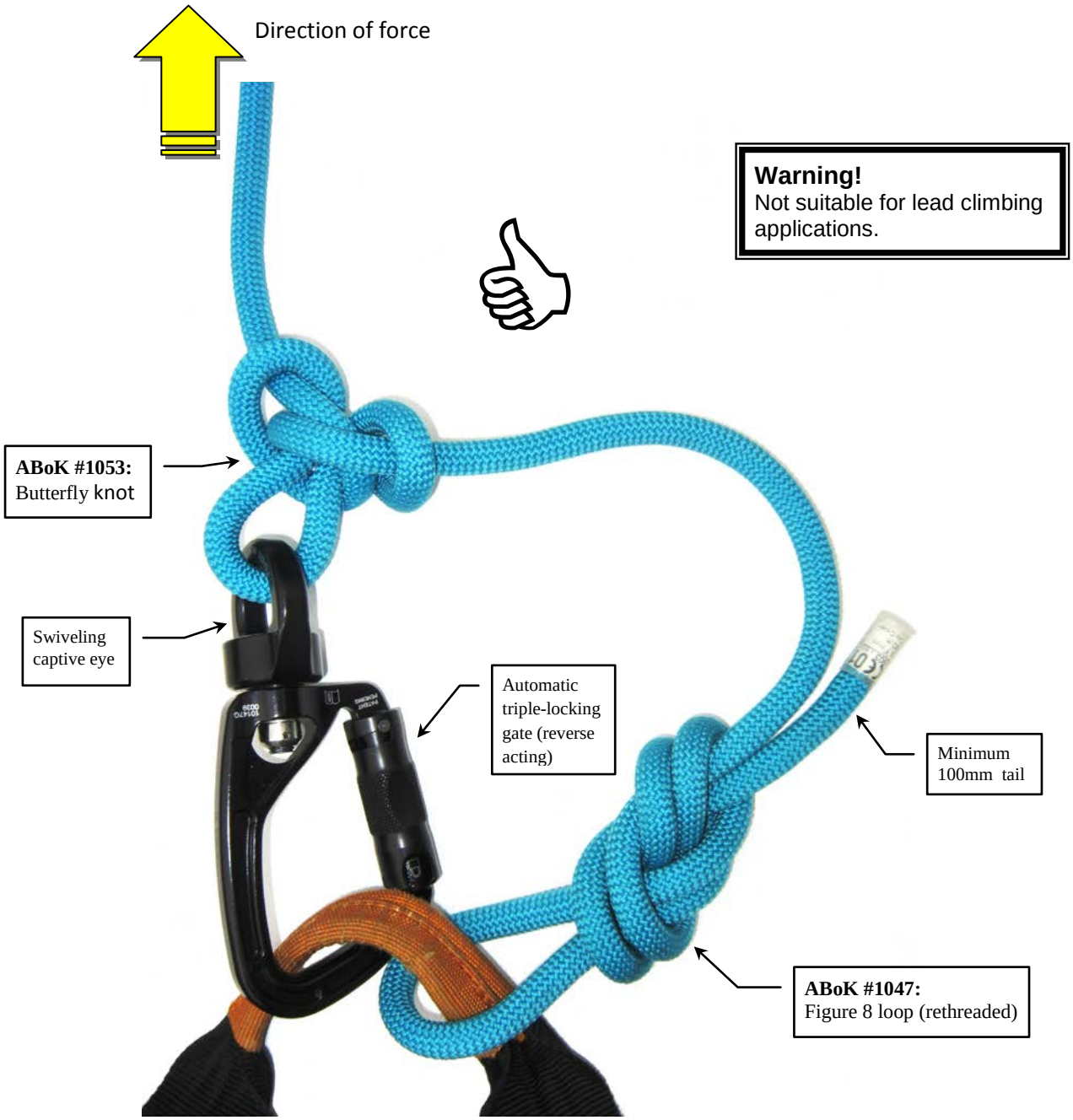
SECURE DUAL CLIP-IN METHOD

PACI protocols require the rope to be attached to a participants harness using a *secure* and *stable* method. The image below offers the *highest* level of security when using a *clip-in system* at a permanent workplace (eg an indoor climbing gym). The method is approved by PACI. Reasonable justification is required if the person in charge of the workplace departs from this standard.



SECURE CLIP-IN AND TIE-IN COMBINATION

This method offers a very high level of security since it combines elements of a clip-in with a proven knot. This method is more secure than a dual clip-in system, since it employs a direct rope-to-harness tie-in. The use of ABoK #1047 (figure 8 loop) provides a secure and stable connective interface in all loading profiles.

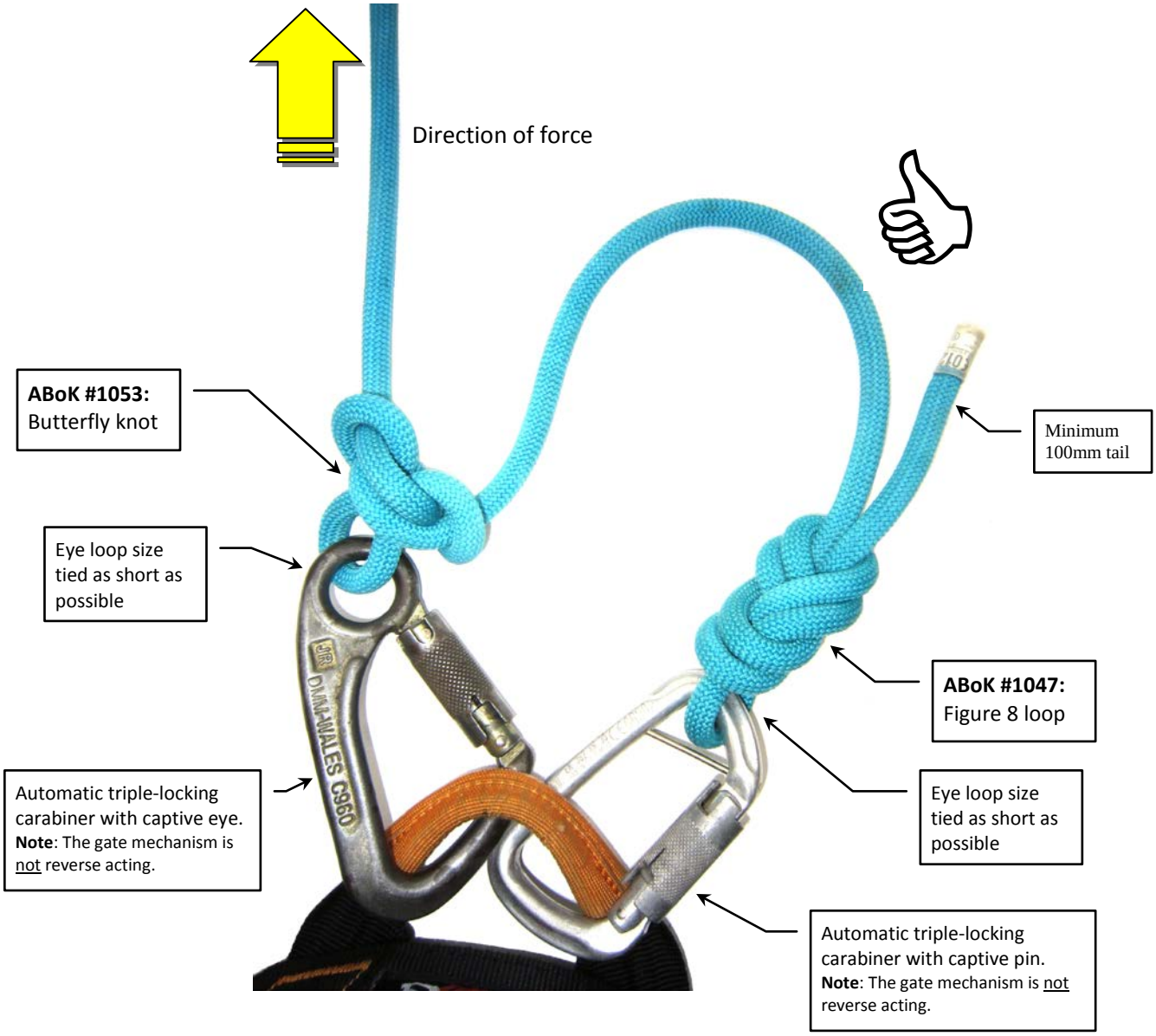


Commentary on combination method:

The user is required to tie a re-threaded figure 8 loop (ABoK #1047). The Butterfly knot (ABoK # 1053) is a permanent fixture set by the facility. The carabiner has a captive swivelling eye and a *reverse acting* automatic *triple-locking* gate. The principle disadvantage with this method is the requirement for the user to tie a knot. If the user makes a mistake, the carabiner will provide acceptable security.

ALTERNATIVE METHODS OF ACHIEVING A SECURE DUAL CLIP-IN

This method is acceptable under PACI protocols however, it is not as secure as using dual swivel eye carabiners with *reverse actuating* automatic gates. If swivel eye carabiners with reverse actuating gates are unavailable, this method may be chosen by the manager of the facility. Cost is not an acceptable excuse at common law – unless the cost of making the change would be financially crippling to the extent that it would force the closure of business.



Commentary on dual clip-in method:

Both carabiners are *resistant* to misalignment caused by cyclic loading. The gates lock automatically and are triple-acting. However, the gates are not *reverse acting*. Loop sizes of knots are tied as small as possible – this prevents the loop from folding across and contacting the gates. Although not as secure as using dual carabiners with swivelling captive eyes, it nevertheless achieves an acceptable level of security.

ALTERNATIVE METHODS OF ACHIEVING A SECURE DUAL CLIP-IN

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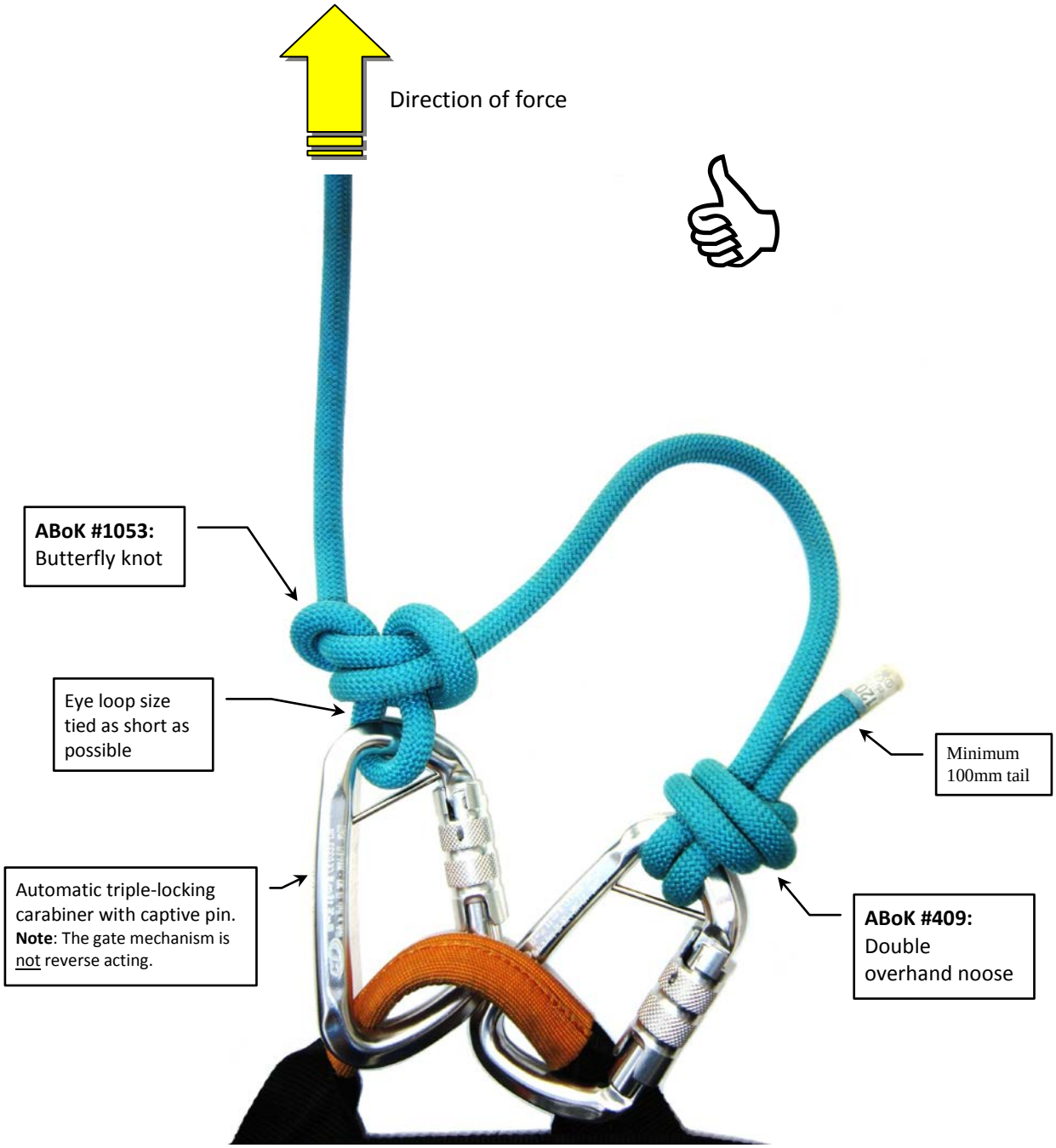


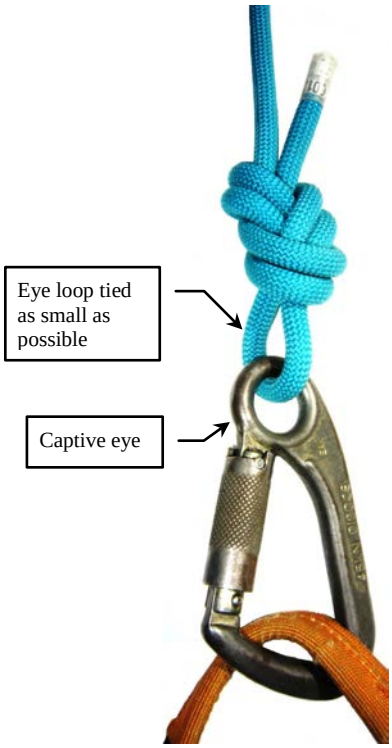
SINGLE CARABINER ATTACHMENT METHODS

All single carabiner clip-in methods have a *critical point* in the system. The critical point is the risk of failure of the single attachment point. If it fails, the result will be potentially catastrophic. Site managers will need to carefully assess the risks of using a single clip-in system at their workplace. Single clip-in systems may be justifiable on challenge ropes courses where participants are required to perform rope change-overs to transfer from one high element to the next. A competent belay person is required so that cyclic loading can be managed / reduced. This method is *not suitable* for use on permanently installed artificial climbing surfaces (eg indoor climbing gyms).

Single clip-in method:

This method uses a single carabiner clip-in to the users harness. The double overhand noose is a secure and stable knot. The carabiner has a swivelling captive eye and an automatic *triple locking* gate. The gate is *reverse acting*. The swivel eye provides the highest level of resistance to roll-out and/or misalignment.

Warning!
None of these methods are suitable for lead climbing applications.



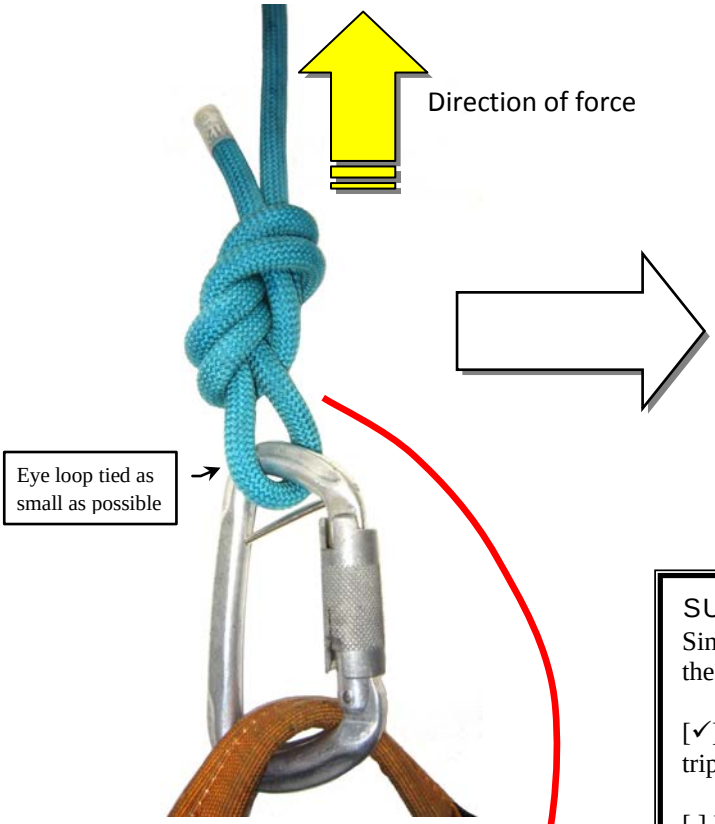
Single clip-in method:

This method uses a single carabiner clip-in to the users harness. The carabiner has a *triple locking* gate and a captive eye. The captive eye ensures resistance to misalignment. This method is not as secure as a carabiner with a swivelling eye.

Note: The loop of the figure 8 knot must be tied as small as possible to prevent risk of *fold-over* across the gate.

SINGLE CARABINER ATTACHMENT METHODS

All single carabiner clip-in methods have a *critical point* in the system. The critical point is the risk of failure of the single attachment point. If it fails, the result will be potentially catastrophic (ie death or permanent disablement). Site managers will need to carefully assess the risks of using a single clip-in system at their workplace. Single clip-in systems may be justifiable on challenge ropes courses where participants are required to perform rope change-overs to transfer from one high element to the next.



Acceptable method: (provided eye loop is tied small)

This method uses a single carabiner clip-in to the users harness. The carabiner is fitted with a captive pin. The captive pin ensures proper alignment.

Warning: The eye loop of the figure 8 knot must be tied as small as possible to prevent risk of loop *fold-over* across the gate.

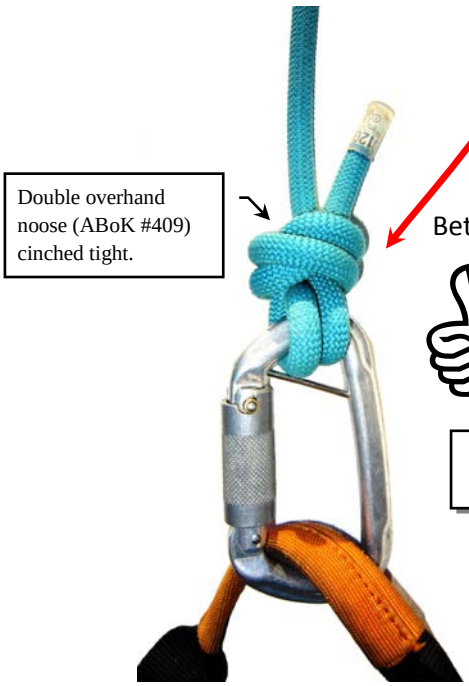
SUMMARY:
Single carabiner connective solutions can be arranged in the following hierarchy:

[✓] Most preferred = Carabiner with swivel eye and triple acting automatic gate

[ ] Preferred = Carabiner with captive eye and triple acting automatic gate (no swivel)

[ ] Acceptible = Carabiner with captive pin and triple acting automatic gate (no captive eye)

[ ] Unacceptable = Carabiner with screw-gate locking mechanism (no captive pin)



Better

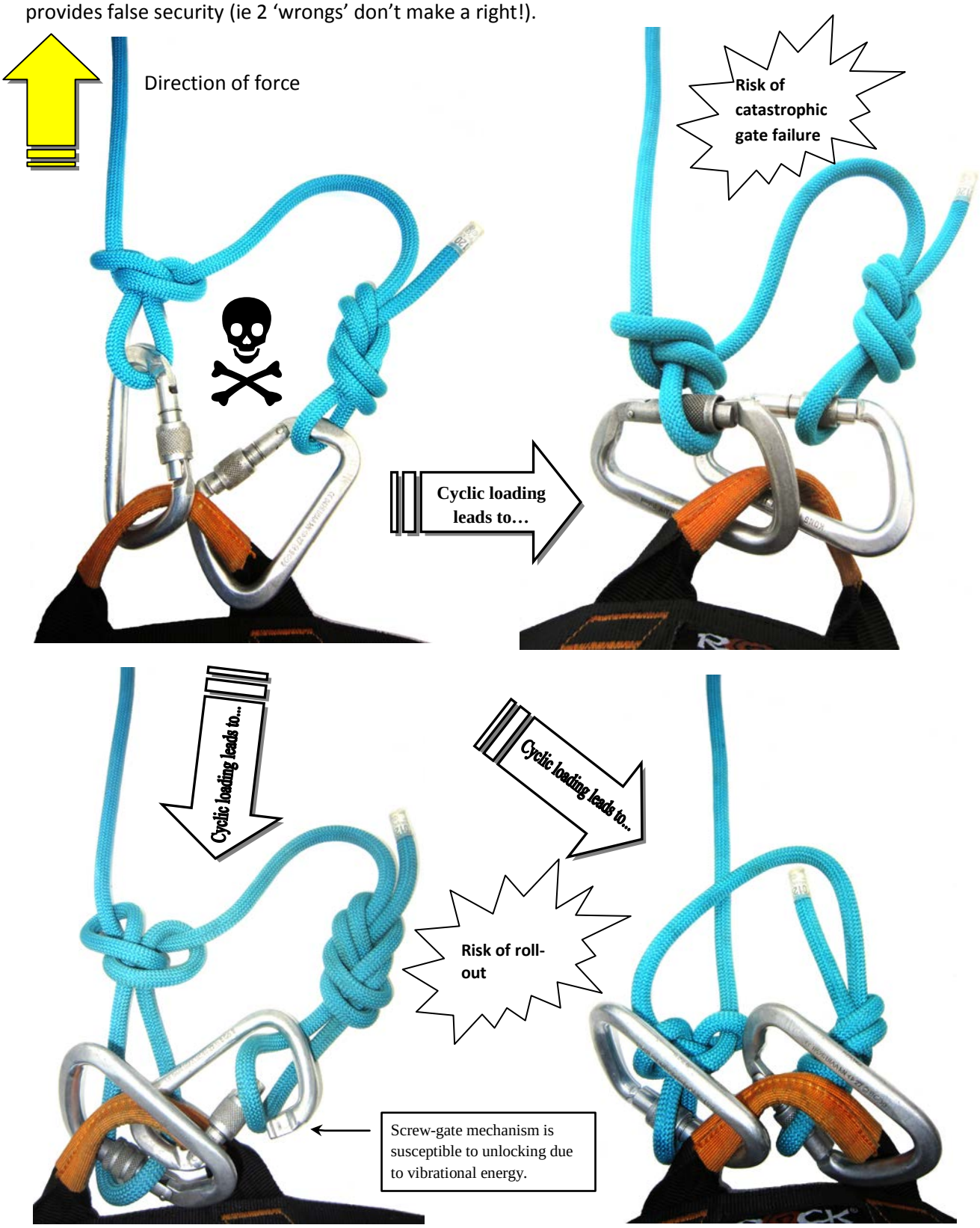
Acceptable method: (with more secure knot)

This method of attaching the rope to the carabiner is secure and stable. It is the preferred method when using carabiners fitted with a captive pin.

Note: The knot is a double overhand noose (ABoK #409) which is cinched tight up against the carabiner.

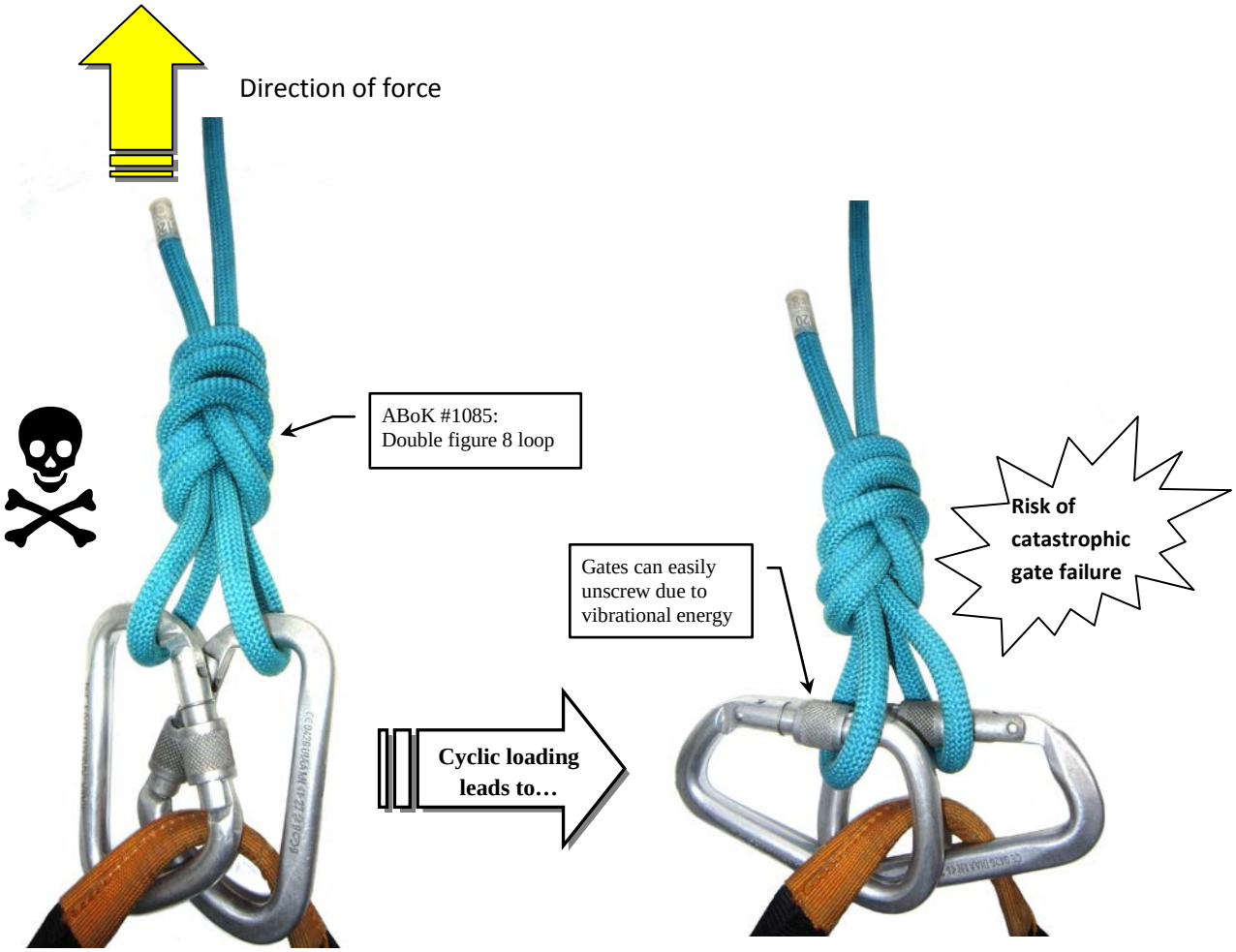
THE FOLLOWING ATTACHMENT METHODS ARE UNACCEPTABLE AND FORBIDDEN UNDER PACI PROTOCOLS

Some facilities attempt to use two standard screw-gate carabiners to achieve connective security. The carabiners are still susceptible to cross-loading caused by cyclical loading. Using two carabiners provides false security (ie 2 'wrongs' don't make a right!).



THE FOLLOWING ATTACHMENT METHODS ARE UNACCEPTABLE AND FORBIDDEN UNDER PACI PROTOCOLS

Some facilities attempt to use a double figure 8 loop (ABoK #1085) because it provides 2 connective loops. Once again, the use of carabiners that are susceptible to misalignment is problematic.

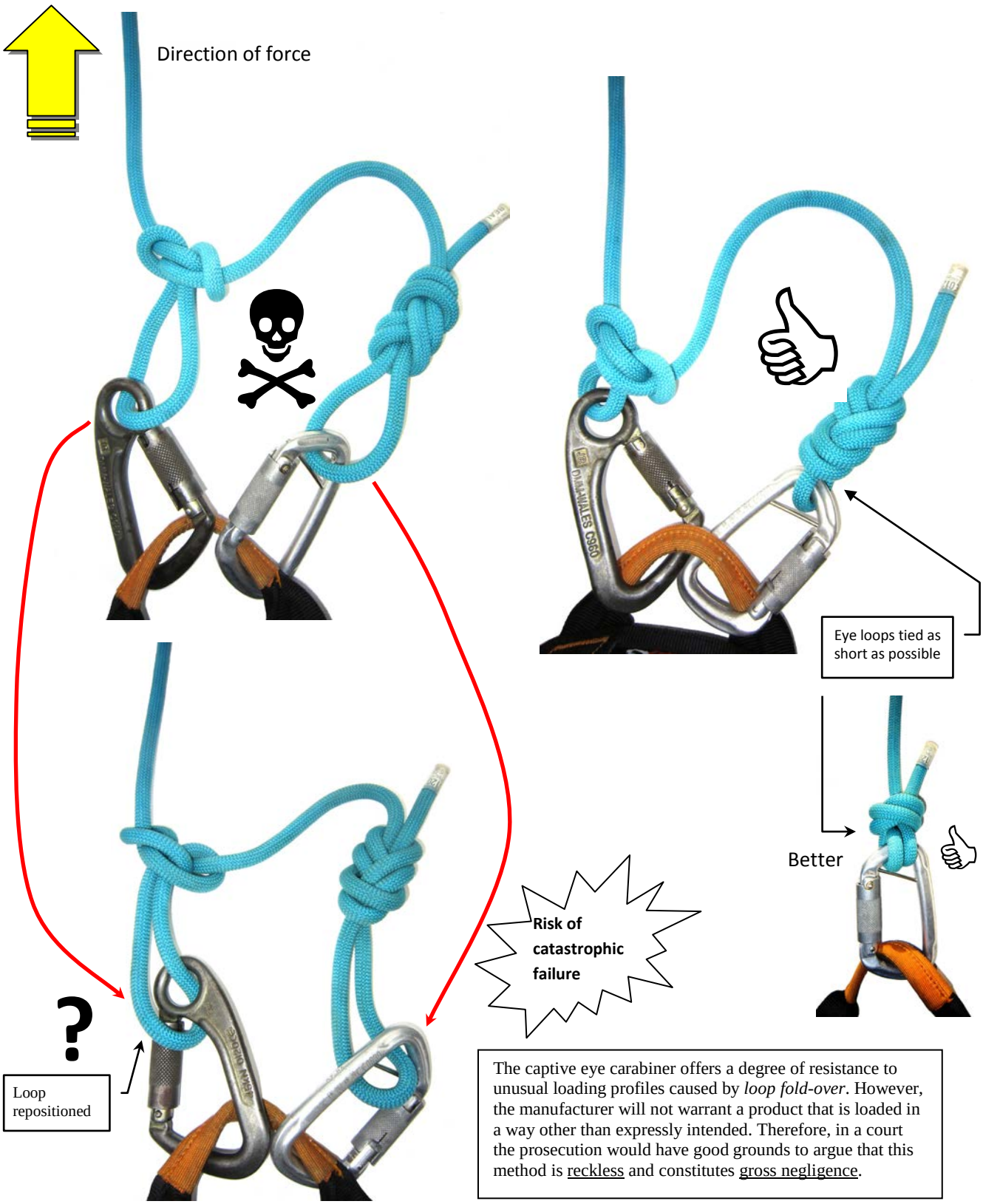


In a court, the prosecution would have good grounds to argue that this method is reckless and constitutes gross negligence.

Warning: Screw-gate mechanisms are susceptible to unlocking caused by vibrational energy.

THE IMPORTANCE OF LOOP SIZE WITH CONNECTIVE KNOTS

Catastrophic failure can occur when loops in connective knots are tied too large. Large loops can inadvertently fold-over the gate of the carabiner – at least one known serious accident occurred in Brisbane QLD where a young boy sustained horrific injuries from a fall. PACI protocols require loop sizes in connective knots to be tied as small as possible. Supervisory staff have a duty to regularly inspect knots to ensure they remain stable and secure.



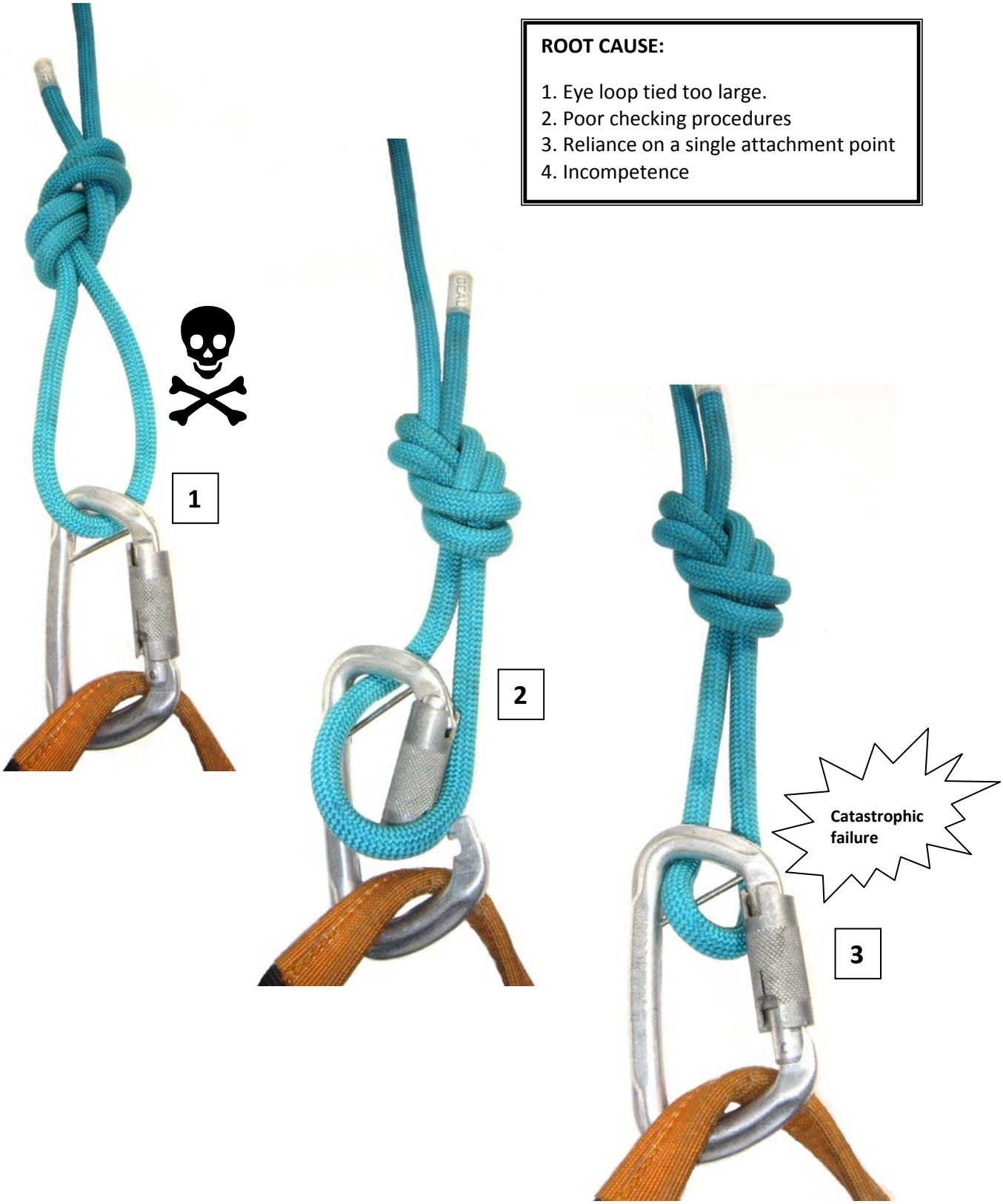
The captive eye carabiner offers a degree of resistance to unusual loading profiles caused by *loop fold-over*. However, the manufacturer will not warrant a product that is loaded in a way other than expressly intended. Therefore, in a court the prosecution would have good grounds to argue that this method is reckless and constitutes gross negligence.

THE IMPORTANCE OF LOOP SIZE WITH CONNECTIVE KNOTS – FAILURE MODES

PACI protocols forbid the use of an over-sized connective eye loop. Loop fold-over can occur – and this failure mode led to a fall from height at Old Petrie Town in Brisbane where a young child sustained horrific injuries.

ROOT CAUSE:

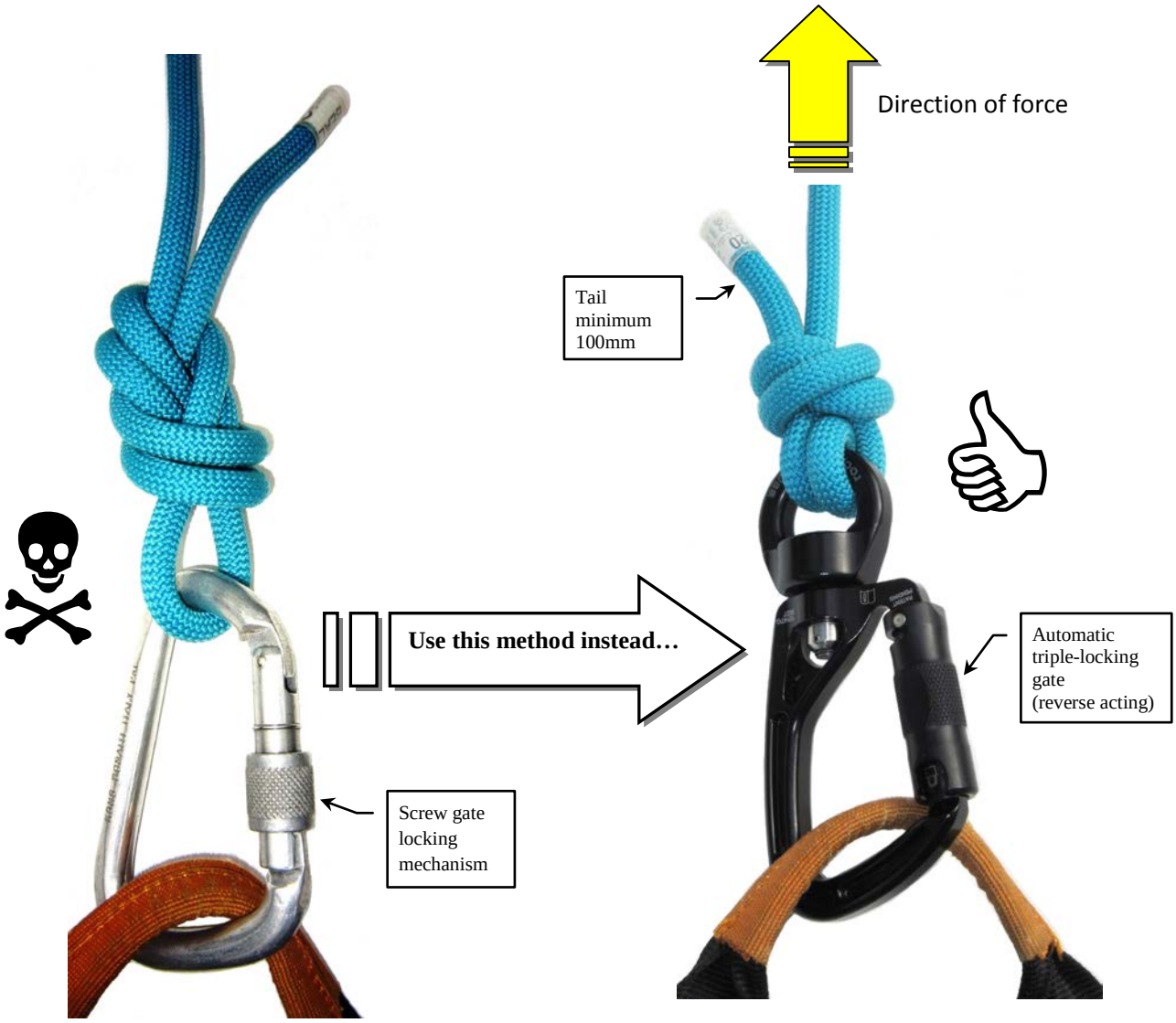
1. Eye loop tied too large.
2. Poor checking procedures
3. Reliance on a single attachment point
4. Incompetence



SUMMARY ON SINGLE CARABINER CLIP-IN METHODS

Before deciding on an appropriate rope attachment method, the person in charge of the workplace must identify the hazards and assess the risks associated with the various options available.

Participant safety must be at the forefront of the decision making process – particularly where children are involved. Although courts do give some consideration to the expense and difficulty of implementing new changes to existing systems, these expenses and difficulties must be significant. A judge would not – for example – accept excuses that the cost of implementing more secure connective systems might be measured in the hundreds of dollars. The cost of the change would have to be to the extent that it would financially *ruin* the business or result in the *complete cessation* of trading. The judge would weigh this argument against the risk of loss of a human life.



Because of the decision in Inspector Victor Page v 4 in 1 fitness Pty Ltd (14 April 2000), the prosecution would have good grounds to argue that this method is *reckless* and constitutes *gross negligence*.

If a single clip-in method is desired, make every *reasonable* effort to use a carabiner that has an automatic triple-acting gate and a swivelling captive eye.

CONNECTORS

Proper consideration must be given to the type of carabiner used to provide the connective interface to the users harness.

Auto-locking carabiner with swivelling captive eye:

This type of connector provides the highest level of security and resistance to misalignment. The eye can swivel 360 degrees and this significantly reduces the risk of roll-out. The eye is circular and this means it is strong in all loading profiles. The triple action (auto-locking) gate is resistant to accidental opening due to gravitational and vibrational energy. The gate is *reverse acting*. Human errors are also unlikely due to the fact that the gate self-locks.

Auto-locking carabiner with captive eye:

This type of connector provides a robust combination of security and resistance to misalignment. The eye is circular and this means it is strong in all loading profiles. The triple action (auto-locking) gate is resistant to accidental opening due to gravitational and vibrational energy. Human errors are also unlikely due to the fact that the gate self locks.

Auto-locking carabiner with captive pin:

This type of connector provides an acceptable combination of security and resistance to misalignment. The captive pin is a cheaper alternative to carabiners with a captive eye. The triple action (auto-locking) gate offers the same benefits as above.

Auto-locking carabiner:

The lack of a captive pin or captive eye means that relative risk levels are higher. The triple action (auto-locking) gate offers higher security than a traditional screw-gate mechanism.

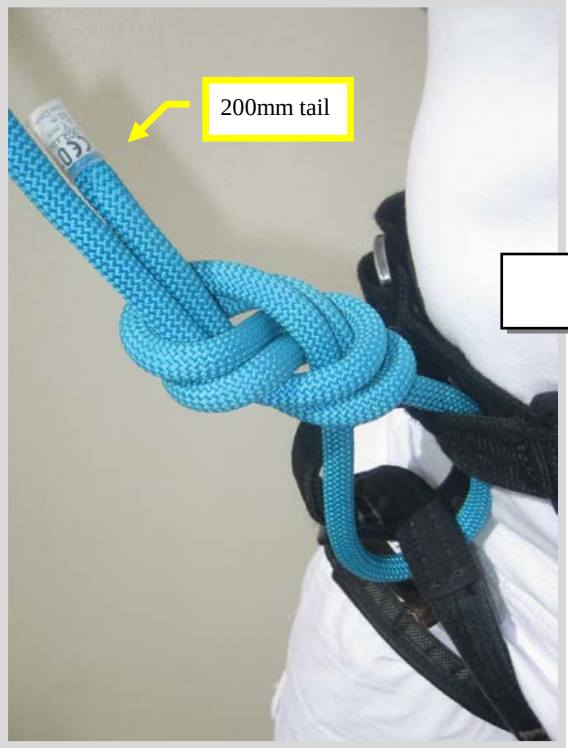
Screw-gate locking carabiner:

The traditional screw-gate locking mechanism is susceptible to becoming unlocked due to vibrational and gravitational energy. The lack of a captive pin or captive eye means that the carabiner is also susceptible to misalignment.

END NOTE – A word on outdoor climbing protocols

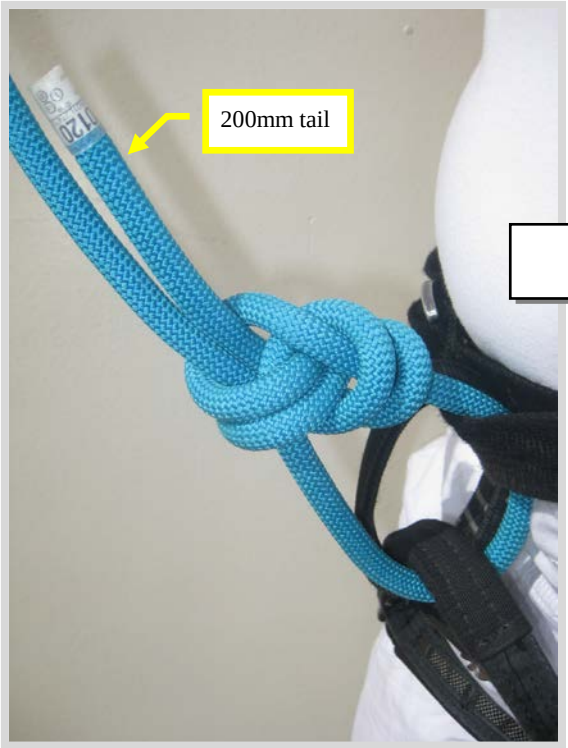
PACI protocols require a direct rope-to-harness tie in method for all outdoor climbing activities on natural surfaces. Clip-in methods are not acceptable in this context. Two types of knots are approved for this purpose as follows:

1. The re-threaded Figure 8 (ABoK #1047); and
2. A secured Bowline (ABoK #1010 with modifications).



Re-Threaded Figure 8 (ABoK #1047)

The traditional method of securing a rope to a harness – known as 'tying-in'.
[ ] Advantages: Simple, easy to learn knot.
[ ] Disadvantages: Can be hard to untie after repeated falls.



Secured Bowline (ABoK #1010)

The Bowline has received (undeserved) bad press. As ropes become thinner and climbers take more falls, the need for a knot that is easier to untie is obvious.
[ ] Advantages: Easy to untie – even after repeated falls.
[ ] Disadvantages: More complex knot to learn – risk of error.