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Industrial Rope Access: Back-up Devices

A Review

A summary of relevant technical and legal information relating to the historical development of industrial rope access back-up devices

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The heightec Group Ltd
July 2013

Introduction

The selection and use of back-up devices for rope access is one of the most interesting and controversial topics in the fall protection industry. Global debate on the subject has escalated recently, although some of the issues regarded as topical now were raised by far sighted users two decades ago.

Back-up devices offer considerable design challenges for manufacturers. They may be used in very differing circumstances, with wide variations in potential loading, rope type, age, condition and tension, distance from the anchor point, etc. Products can behave in ways that the user doesn't expect and users can do things that product designers hadn't anticipated (or had hoped they wouldn't).

It's not enough to tell people not to do a certain thing - some human responses can't be avoided. Previous assumptions about the degree to which any situation could be regarded as "safe" are now being questioned and closer attention is being paid to the circumstances in which products are used. Critically, the concept of foreseeable *mis*-use is seen as increasingly important in rope access, yet this concept was firmly established in UK law in 1974 and was present before that.

Product standards are being increasingly used as a primary indication of product suitability. This is a mistake (for details, see this document!). Standards were only ever intended to establish that a product meets *minimum* standards and most do not take wider issues into account. Conformance to a standard can only be regarded as an *initial* indication of suitability. If a manufacturer is to be certain of the reliability of a product, all potential parameters must be tested for. When it comes to a judgement on what is safe in the field, we all have a role; designers, manufacturers, specifiers, users, buyers, supervisors, trade associations, trainers, assessors, auditors.

heightec has followed the development of these issues whilst researching, testing and developing its own solution to the complex requirements of a versatile back-up device. It seemed that a proper understanding of the current state of affairs required all of the information to be gathered together and this document is our own reference point for establishing what a product must do to satisfy technical and legal requirements in a robust and predictable manner.

This document is a review – it does not identify any specific issues, propose solutions or discuss product characteristics. Further detail on these topics will be provided in a separate document. Whilst much of what is gathered here may be already known to many, there does seem value in presenting all aspects together and we hope there will be something here relevant to everyone.

A point of particular interest is the degree to which legal requirements, that can seem vague and generic, can provide unexpected insight when interpreted with respect to certain situations.

Keith Jones
Managing Director
July 2013

Document subject to update - please check at www.heightec.com\downloads

Editorial Notes

This review provides a summary of relevant technical and legal information relating to the historical development of industrial rope access back-up devices.

All of the information is presently (or has been previously) available in the public domain. Each document reviewed provides background and/or context on the technical and/or legal challenges faced by manufacturers of fall protection devices and employers of industrial rope access technicians. Where extracts have been provided from relevant information the intent has been to do so in a balanced way.

The review is written largely from a United Kingdom (UK) perspective, this being the regulatory framework within which heightec primarily operates.

heightec sees this review as a 'living' document and constructive feedback and/or contributions are actively sought; in particular from those who are able to provide a non-UK view on the design, selection and use of back-up devices in industrial rope access.

Feedback can be submitted, via email (review@heightec.com), to the Technical Director.

David Thomas, CEng, FICE, CFIOSH
Technical Director
July 2013

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EXECUTIVE SUMMARY

Rope access users have begun to question previous assumptions about the degree to which back-up devices can be regarded as safe. Attention is being paid to the circumstances in which devices are being used and, critically, the possibility of foreseeable mis-use. Much has been written over the last twenty years or more. The key issues identified by this review are:

1.1 Technical

1. A personal fall protection system shall be so designed, installed and used as to prevent unplanned or uncontrolled movement of the user.

2. Only products fulfilling the *essential requirements* may be placed on the market and put into service. PPE designed to prevent falls from a height or their effects must be designed for the *foreseeable conditions of use*.

3. When you buy something, consumer law says the item must be 'fit for purpose'.

4. Ensuring that equipment has a CE mark is only one of the factors involved in the selection process. Just because a piece of equipment meets a standard it doesn't mean it will work in every field condition, or perhaps even in most field conditions.

5. When selecting a back-up device, it is essential that the probability of foreseeable misuse and the consequences of such misuse are assessed.

6. BS EN 12841: 2006 lacks engineering input and is full of confusing statements. It requires a comprehensive revision.

7. One of largest potential variables is between new and used rope, but there are others such as type of rope, conditioned, wet or dry, etc.

8. A grabbing action is a known reflex in fall situations and constitutes a potential danger. Towed back-up devices prove a particular challenge, not least due to the requirement to address *reasonably foreseeable misuse*.

1.2 Legal

1. Workplace risk must be controlled in a manner that is "reasonably practicable". This involves weighing a risk against the trouble, time and money needed to control it. The decision is loaded in favour of health and safety.

2. "Duty of care" is the obligation to exercise a level of care towards an individual, as is reasonable in all the circumstances, to avoid injury or loss of property to that individual.

3. "Foreseeability" does play a part in assessing risk, or lack of safety. There is no absolute and unchanging concept of lack of safety. The foreseeability of a risk is distinct from the question whether it was 'reasonably practicable' to avoid it.

4. A working place is "safe" if there is nothing there which might be a reasonably foreseeable cause of injury to anyone working there, acting in a way in which a human being may reasonably be expected to act, in circumstances which may reasonably be expected to occur.

5. Employers must make a 'suitable and sufficient' assessment of the risks to the health and safety of their employees. A risk assessment should ensure the *significant* risks and hazards are addressed.

6. Employers must ensure that work equipment is used only for operations for which, and under conditions for which, it is suitable.

1.3 Product testing

There are many factors that can lead to products behaving in ways that the user doesn't expect, or users behaving in ways which product designers don't anticipate. It's not enough to tell people not to do a certain thing; some human responses to events can't be avoided.

Testing to harmonised standards – that give a presumption of conformity with the basic health and safety requirements of the 89/686/EEC Directive – is conducted on *new* rope. On occasion, there may be optional functional requirements after conditioning, e.g. heat, cold, oil and dust (see 4.1.10 in BS EN 12841: 2006). An alternative route to conformity is to submit a technical file.

The PPE Guidelines[1] state, "… a harmonised standard does not necessarily cover all essential requirements …". Ultimately, the decision to grant a CE-mark lies with the Notified Body (NB). What a manufacture claims is only as good as the thoroughness and experience of the NB and how comprehensive the harmonised standard is.

Standards do not cover 'real life' scenario and it would be difficult for a process driven by type-approval to take account of the number of variables that may be encountered. For industrial rope access it has been shown that there are many variables that will affect the performance of a back-up device on a particular rope:

- The age of the rope (and hence it's stiffness and degradation);
- The rope diameter;
- The rope brand (and the construction of the core and sheath);
- The condition of the rope, e.g. its cleanliness (dirt/grit);
- Whether the rope is contaminated, e.g. paint, grease, oils, etc.;
- Whether the rope is wet, dry, cold/hot (air temperature), etc.;
- The number of users and their mass;
- The length of the fall (taking into account the length of the connecting element, e.g. cowstail, and the fall factor) and whether the lanyard length is shortened during a rescue;
- The type of lanyard, e.g. knotted dynamic rope, webbing, Dyneema®, etc.; and
- The material from which the device is manufactured and its susceptibility to wear and tear.

Other influences in testing include:

o Distance from the knot;
o Tightness of the knot (and whether it has been pre-loaded);
o Whether the 'working rope' is loaded, e.g. rescuer ascending a casualty's rope; and
o The use of a harness – providing a 'system' approach to testing (and a demonstration of compatibility).

In conclusion, a manufacturer of fall protection equipment has to do far more than confine itself to the testing regime specified within product standards, wherever those standards have been published.

1 http://ec.europa.eu/enterprise/sectors/mechanical/files/ppe/ppe-guidelines_en.pdf

2 PART A - HISTORY

This part looks briefly at the background to rope access and the equipment used. A resume is provided of the main issues surrounding the most commonly used back-up device; along with some of the industry trade association responses. Research identifying a number of other findings is also summarised.

2.1 Industrial Rope Access

2.1.1 What is 'rope access'[2]

IRATA International define a rope access system as:

> "… a safe method of working at height where ropes and associated equipment are used to gain access to and from the work place, and to be supported there …".

Rope access techniques can only be carried out in a reliably safe manner where:

- Those undertaking the work are competent, i.e. suitably experienced and trained, particularly in the method(s) of access and equipment that they will actually be using, and have knowledge of and can recognise any limitations of their equipment, in order to avoid misuse; and
- The work is properly planned, managed and supervised by competent person(s).

The primary objective when using rope access methods is to plan, manage and carry out the work with minimal accidents, incidents or dangerous occurrences, i.e. to ensure a safe system of work is maintained at all times, and with no damage to property or harm to the environment.

Rope access requires a back-up device. This is a rope adjustment device that is attached to the back-up safety line in order to protect the technician from a fall if the main working line fails or if the technician slips or loses control in any way. The back-up device is intended to lock on to the safety line without causing damage to the rope, and absorbing any shock load that may occur.

2.1.2 Equipment used

For over thirty years industrial rope access in the UK has used equipment predominantly designed and manufactured for caving. Initially, with no applicable industrial Standards (ENs), it was not possible to choose equipment meeting "standardised" criteria. Equipment was chosen because it provided the minimum level of safety that was considered for the then workforce experienced in caving and climbing[3].

In the early days[4], "… the Petzl Shunt was adopted to provide a redundant back-up system. The only other fall arrest devices available in the early 1980s were for use on thick twisted rope which were impractical …". Although the Shunt conformed to EN 567 (and was designed for mountaineering to provide additional security for double rope pull down abseils with Figure-of-8 descender devices) it was considered an appropriate back-up as it had no teeth to damage the rope in a dynamic fall.

Tests showed later that when used for rope access, if both ropes are put into the device and there is a failure in the working line the Shunt does not activate on the back-up line. Thus

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2 IRATA International, www.irata.org/what_is_rope_access.php

3 http://rattrapmag.com/2013/02/03/clucking-shunts-the-search-for-the-back-up-holy-grail-part1/

4 IRATA Trainer and Assessor Workshop 26 March 2011, Risk assessment, selection and safe use of descender and back-up devices, Discussion Document, Mark Wright

began many years of discussion and debate about the appropriateness of the device; not least that it may be grabbed, and be rendered inoperative, by an operative during a fall (considered to be 'reasonably foreseeable misuse').

2.2 Back-up devices

The rope access industry adopted caving equipment. Accordingly, the Petzl Shunt was almost universally used. Whilst the rope access industry as a whole has a good safety record questions about the device's suitability have been raised over many years.

2.2.1 Introduction

Aware of the weak point in the use of the Shunt the IRATA Health, Safety and Equipment Committee at their Meeting on 7th July 1999 discussed the issue of back-up devices. The intent was expressed to draw up, on behalf of the industry, a specification and/or set of requirements for an improved device and to make this widely available to manufacturers and/or suppliers. This did not happen *per se* although the International Code of Practice (ICOP), sometime later, addresses the selection criteria for back-up devices[5].

2.2.2 Manufacturer's Information

Between 1999 and 2012 a number of alerts were issued by the manufacturer of the Shunt. These highlighted, initially, the need for "special training" and, later, that the device did not meet certain product standards. A concern over two-person rescue was also raised before, eventually, it was recommended that that the device should not, whilst towed by a cord, be used as a back-up device in rope access.

✓ 1999

Petzl, via Lyon Equipment Ltd., issued some "Shunt Information" (Crolles, 20th October 1999) stating:

> **Use of the Shunt in professional rope access work**[6]
>
> The Shunt is designed as a back-up safety device for use in conjunction with a descender. It is primarily designed for use on double rope, but will also operate on a single rope. In addition to its use as an abseil security device it is also certified to EN 567 as an ascender.
>
> Petzl recognise that the Shunt is widely used in rope access as a back-up device mounted on a secondary single safety rope, attached to the user by a lanyard or cow's tail. Because of the need for special training this use falls outside the scope of the general instructions issued with the Shunt. The required skills are the province of the professionally trained and qualified rope access operative. The way in which the Shunt operates allows the user to pull it down the rope without prior de-weighting. (Exactly like a prusik loop). This is a major advantage in normal use, but special training is required to ensure that this feature is not mis-applied in emergency.
>
> Professional operatives may choose to use the Shunt as a rope-access and work positioning back-up safety device if they have received and mastered appropriate training. Responsibility for such use remains with the employer and the user.

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5 Section 2.7.7

6 Information was also issued about the Stop D09 and the I'D D20 descenders (Crolles, 4th August 1999)

- ✓ **2009**

Petzl issued subsequently an amended statement (Crolles, May 12th 2009):

> **Petzl statement on a special use of the Shunt**
>
> The Shunt is designed as a back-up safety device for use in conjunction with a descender. It is primarily designed for use on double rope, but will also operate on a single rope. In addition to its use as an abseil security device it is also certified to EN 567 as an ascender. Normally, Petzl recommends ASAP as a back-up device in rope access.
>
> In specific situations, Petzl recognises that the Shunt is widely used in rope access as a back-up device mounted on a secondary single safety rope, attached to the user by a lanyard or cow's tail. Because of the need for special training this use falls outside the scope of the general instructions issued with the Shunt. The required skills are the province of the professionally trained and qualified rope access operative. The way in which the Shunt operates allows the user to pull it down the rope without prior de-weighting (exactly like a prusik loop). This is a major advantage in normal use, but special training is required to ensure that this feature is not mis-applied in emergency.
>
> In specific situations, professional operatives may choose to use the Shunt as a rope-access and work positioning back-up safety device **if they have received and mastered IRATA training**. Responsibility for such use remains with the employer and the user.
>
> We remind you also that in this application Shunt is not covered by EN 353-2 and EN 12841 standards. For your information, the instructions for use are also available on our website.

- ✓ **2009**

A further statement was made shortly thereafter (Crolles, May 25th 2009):

> **Petzl statement on continued use of the Petzl Shunt (B03) in professional rope access work**
>
> The Shunt is designed as a back-up safety device for use in conjunction with a descender. It is primarily designed for use on double rope, but will also operate on a single rope. In addition to its use as an abseil security device it is also certified to EN 567 as an ascender.
>
> Petzl recognise has recognised that the Shunt is widely used in rope access as a back-up device mounted on a secondary single safety rope, attached to the user by a dynamic lanyard or 'cow's tail'. Because of the need for special training, this use fall outside the scope of the general instructions issued with the Shunt. The required skills are the field of the professionally trained and qualified rope access operative. The way in which the Shunt operates allows the user to pull it down the rope without prior de-weighting, similar to a prusik loop. This is a major advantage in normal use, but special training is required to ensure that this feature is not mis-applied in emergency.
>
> The use of the Shunt as a back-up device for loads greater than one person requires careful consideration. Other devices are currently available which are more suited to this task.
>
> Professional operatives may choose to use the Shunt as a rope-access and work positioning back-up safety device must have received, and mastered, appropriate training. Responsibility for this remains with the employer and the user.

In 2005 Petzl introduced the ASAP mobile fall arrester for use on a single EN1891 low stretch rope. This device is appropriate in many rope access situations including 2 person rescue, and is type approved to EN353-2 and EN12841 type A.

✓ 2011

In Spring 2011, during an IRATA Technical Meeting at the V.axess training centre in Crolles, IRATA conducted tests to evaluate the performance of the Petzl Shunt as a back-up device. These indicative tests:

> "… demonstrated a repeated failure of the IRATA Petzl Shunt technique to stop a fall in case of rupture of the working line during abseiling. Of 17 tests conducted, approximately 25% of the IRATA experts failed to stop their fall with the IRATA back up technique (Petzl Shunt + small string + knot) …".

The Memorandum from Petzl to the IRATA Technical Coordinator (Crolles, 16th September 2011) continues:

> "There were clearly many variables – not least of which was the experts' readiness for the tests, and yet the technique still did not stop all falls.
>
> In regard of both these observations and our constantly evolving product experience, Petzl cannot continue to support IRATA's use of the Petzl Shunt as a principle back up device used in this manner …".

✓ 2012

In January 2012 Petzl released a statement on a special use of the Petzl Shunt. This statement superseded all previous statements and communications relating to this particular use of the Petzl Shunt.

> "**Petzl statement on a special use of the Petzl Shunt**
>
> **Context:**
>
> Since 1999 Petzl has provided specific information regarding the special use of the Petzl SHUNT as a back-up device for industrial rope access. Petzl required that users must have received and mastered IRATA (Industrial Rope Access Trade Association) training or similar and must also use the Petzl SHUNT within the current "IRATA method".
>
> Extract from the June 2009 statement:
>
> "Professional operatives who choose to use the Petzl Shunt as a rope-access and work-positioning back-up device **must have received and mastered IRATA training or similar, and must use the Petzl Shunt with IRATA method**. Responsibility for this remains with the employer and the user."
>
> **Analysis:**
>
> In the light of incidents and accidents, indicative tests have been conducted, including – but not limited to – a workshop in March 2011 with rope-access experts present. The findings of these indicative tests demonstrate that releasing a towing cord while towing a Petzl Shunt as a back-up device is not consistently effective:
>
> - In an emergency situation, the natural human reflex is to increase the grip on the cord, therefore reducing the likelihood that the cord will be pulled from the hand.
> - Additionally, this natural reflex may override any conscious action to open the hand and release the cord.

- Consequently, either of these hazards could result in overriding the braking function of the Petzl Shunt.

Following these tests, working sessions with IRATA alerted Petzl to the fact that there has not been special training sufficient to minimize this potential risk. Testing and experience demonstrates that human response to emergency situations, even among expert users and highly trained professionals, is not completely predictable.

Conclusions:

- Previous Petzl statements required special training for this specific use of the Petzl Shunt. The lack of any described methods or special training therefore makes these previous Petzl statements obsolete.
- As a measure of precaution, Petzl recommends to NOT use the Petzl Shunt, while towed by a cord, as a back-up device in rope access".

A list of 'Frequently asked questions' (FAQs) were also prepared:

http://www.petzl.com/en/pro/news-pro/2012/01/10/petzl-statement-special-use-petzl-shunt

2.2.3 IRATA Response (2012)[7]

After considerable debate, IRATA issued a Statement in response to the Petzl 10th January 2012 statement on the use of the Petzl Shunt as a back-up device for industrial rope access. It stated:

> "The Petzl statement highlights the well-known risks of misuse when performing a continuous descent whilst holding the cord should an incident occur, e.g. mainline failure, out of control descent.
>
> IRATA has always acknowledged these risks and notes that Petzl's recommendation is not to use the Petzl Shunt as a backup device if it is towed with a cord during continuous descent.
>
> It is the opinion of IRATA that this does not eliminate the use of the Shunt with a cord as a backup device during certain tasks and using specific methods of handling.
>
> IRATA therefore recommends the following to IRATA members and IRATA technicians:
>
> - **The shunt should not be used as a back-up device if it is to be continuously towed in descent** however it could be used as an independent device when operated separately from the main descender device …"

Some 'Frequently Asked Questions'[8] (FAQs) were also issued, to be read in conjunction with the IRATA Statement. These include the following:

> 1, What are the specific risks with the Petzl Shunt that I need to re-address in my risk assessments
>
> - Risk 1= Panic Grabbing or holding the rope above the Petzl Shunt during any manoeuvre
> - Risk 2= Panic Grabbing or holding the Petzl Shunt during any manoeuvre
> - Risk 3= Rescue use with a 2 person load – particularly in training
> - Risk 4= Use by users over 100kg

[7] http://www.irata.org/safety_notices/Shunt Geneva version Rev 0.pdf

[8] Use of Petzl Shunt as a back-up device, Towed with a chord during continuous descent, http://www.irata.org/safety_notices/FAQ's for IRATA Statement Shunt Rev 0.pdf

- Other potential risks exist in relation to the foreseeable uses and misuses of the Petzl Shunt in your particular applications during industrial rope access. These must be identified and treated by the user's complete risk analysis prior to specification and subsequent use.

8, Will IRATA allow towed back-up devices if their performance and effectiveness can be demonstrated.
Answer:
Yes

This was revised[9] in November 2012 (to reflect testing undertaken at Gridins):

IRATA therefore recommends the following to IRATA members and IRATA technicians:

- **The shunt should not be used as a back-up device if it is to be continuously towed in descent however it could be used as a back-up device when operated separately from the descender providing the other considerations set out below are addressed.** …

It also states:

"Consider the following when selecting back-up devices for rope access, rope access rescue and associated training;
1 Known risks and reasonable foreseeable misuse
2 Manufacturer's user instructions
3 Clearance distances
4 Rope stretch
5 The load rating of the of the back-up device
6 The implications of the introduction of different methods and equipment into the training programme and work sites i.e. familiarisation with equipment and techniques
7 The potential for uncontrolled descent
8 Performance in specific work environments …".

It concludes:

"The robust approach that IRATA have taken to address changes or potential changes in equipment and methods should accelerate innovation in both methods and equipment to improve the safety and effectiveness of the secondary system in industrial rope access".

9 IRATA Shunt Statement, Revised November 2012, http://www.irata.org/docs/pdf downloads/IRATA Statement.pdf

2.3 Other Research

Over the years other ad-hoc testing has been undertaken to look at working rope failure, rescue loads and testing in work situations. Safety bulletins have also been prepared about rescue training.

2.3.1 Millers Dale Bridge, Derbyshire (1994)

In response to discussions about how users react in the event on a working rope failure a series of tests was conducted at Millers Dale Bridge, Derbyshire, on 22nd December 1994. Two scenarios were investigated:

- Abseiling off the end of the operating [working] rope
- The operating rope being severed, causing a fall

Conclusions

The conclusions were:

1. Shunts can work effectively as a back-up device when operated by experienced users.
2. Three techniques were used to drag the shunt down the back-up rope. No technique was found to be better or worse than any other during these tests.
3. The users felt more proficient and at ease as the tests progressed. However, whilst their stopping distances as a group show an improved progression, their individual progress shows a less obvious improvement.
4. The average stopping distance after abseiling off the end of the rope was 2.7 m.
5. The average stopping distance in the severed rope scenario was slightly longer at 3.1 m as expected.
6. Discomfort from a jarring/whiplash effect was felt upon falling the larger distances.

Notes

1. It is accepted that the users were both very experienced and had prior knowledge of a rope failure so these stopping distances should be regarded as the best stopping distances in each case.
2. Some concern was voiced about the likely reaction of novices in such situations, as a small difference in discovery/reaction time appeared to have a major effect on the result.
3. These tests were done to gain a greater appreciation of a user's reaction when the operating rope fails. The sample was very small and the margin for error high. The results should not be taken as conclusive evidence of any element.
4. Measurement inaccuracies also occurred because of two factors:
   a) Rope measurements were taken under either tensioned or slack condition
   b) Each operator's back-up sling was a different length

However, the effect of these inaccuracies is small and possibly irrelevant. Sufficient information is given for anyone wishing to work out the results more accurately.

2.3.2 IRATA Assessors' Workshop (2007)[10]

An Assessors' Workshop undertook tests on back-up systems under rescue loads to replicate the risks encountered during routine training.
Tests had been proposed with the premise that:

[10] IRATA Assessors Workshop, 21st April 2007, Tests on backup systems under rescue loads to replicate risks encountered during routine training, www.irata.org/docs/safety_notices/Spanset_workshop_Results.pdf

> "… we may be happy to accept higher risks during an actual rescue compared to during normal working, but during training which is a "normal" activity there are actually higher potential risks that we are not necessarily fully aware of …".

It was suggested that:

> "It is quite possible that during training we have a low incident occurrence due to the effectiveness of the main working system rather than the back-up system. The back-up system is rarely if ever used, but should it be used it may prove ineffective. IRATA is also in possession of a large amount of recorded data to support the working systems, but there is very little recorded data that supports the effectiveness of back-up systems.
>
> The tests … do not question working issues on site and we do not feel that rope access activities on site will necessarily be affected. We do however expect training organisations to consider the potential risks of some of the activities they routinely request trainees to undertake, as the tests do question these areas. It may be that changes in the way we carry out training activities may well be sufficient to resolve some of the issues identified …".

Recommendations were made:

- Further testing is advisable and suggestions would be welcome for areas that may not have been addressed during these tests.
- The height at which rescues are carried during training is important. Free space below for travel will be required.
- Care must be taken near knots especially.
- The re-belay test did not load the body side of the Shunt, it wrapped under the pin, but were we lucky or is this always the case?
- Should the knot passing rescue be removed from the assessment as being unrealistic and rare in normal work, but creating unnecessary risk?
- Can we be inventive and create assessment situations that cover the technique, but remove the specific risk that some scenarios include?
- Will using a mannequin be better as we will halve the risk, but we will still have 50%?

2.3.3 IRATA Safety Bulletin SB21.1 (2011)[11]
Rescue training incidents

This bulletin notes that:

> "There have been several incidents during two-person rescue training resulting from uncontrolled descents. These have involved a variety of circumstances including all levels of technicians …".

[11] Rescue training incidents, http://www.irata.org/safety_notices/Safety Bulletin 21.1 - Rescue training incidents.pdf

Further,:

> "… There is no one single solution to all the issues raised. The following information includes a variety of control measures which need to be considered with reference to the whole document. The application of the possible control measures should be viewed in the context of the training environment; this includes considering the techniques and equipment used during training, as well as the facilities available for any particular venue …".

2.3.4 IRATA Safety Bulletin SB21.2 (2011)[12]

Discussion on rescue training incidents

The function of a back-up device is to prevent a fall or injury in the unlikely event of any kind of problem with the working line system, i.e. not just main line failure. This bulletin discusses the selection of back-up devices used for two-person use and, usefully, looks at the following topics:

- IRATA ICOP
- Petzl Shunt (EN 567 Rope clamps – "mountaineering" standard for recreational use)
- Other back-up devices
- Control measures in rescue training (in no particular order):
    - Height of rescue
    - Trainer/assessor supervision
    - Alternative techniques
    - Additional fall protection systems
    - Other options
- Summary of standard operational checks before descent

2.3.5 IRATA Technical Report on testings done at Gridins, Lithuania (2012)[13]

IRATA arranged the undertaking of a number of practical tests at the IRATA ITEC held at Gridins, Lithuania in May 2012, on various rope access equipment and systems to supplement other sources of testing and information to assist members in the selection of equipment and systems.

> "The tests were designed to be similar to work situations rather than e.g. EN tests which require only the use of new unused equipment, conditioned rope, measurement of forces and set parameters to give reproducible results but which may be different from rope access work …".

The following was noted:

> "**Factors which may affect comparison with other tests**
>
> 1 100kg mass was chosen as the most common value for industrial tests, but loads above or below 100kg may produce different results.
>
> 2 The use of sand bags are likely to give less reproducible results than methods in EN tests but are more practical for our chosen test locations, also they may represent the action of a human body in a more realistic manner than a steel mass.
>
> 3 One of largest potential variables is between new and used rope[14], but there are others such as type of rope, conditioned, wet or dry, etc.

[12] Discussion on rescue training incidents, http://www.irata.org/safety_notices/Safety Bulletin 21.2 - Discussion on rescue training incidents.pdf

[13] http://www.irata.org/docs/pdf downloads/IRATA Technical Report.pdf

4 Backup devices were tested with lanyards [cow's tails] supplied, or approved by the manufacturer. One factor in 'total fall distance' is the length of lanyard and the device position above or below the descender of the user. Greater total fall distance is likely with longer lanyards, or for those designed to hang down or 'follow' the user.

5 Back-up devices were tested 1m below anchor point - a likely position during a descent, though total fall distance and forces will vary with length of rope above the device.

6 Variability in tying and pre-tensioning knots is more significant with a small length of rope compared to a longer rope where the 'end effect' is diluted …".

The summary includes the following statement:

"**Back-up systems, devices performance and rope stretch**

- o When an operator is in a static work position, back-up devices that are positioned above the operator limiting any potential free fall will minimize impact forces and fall distance in the event of a working rope failure.
- o Towed type back-up devices that require the operator to release the tow, or for a fail to safe device to engage have a greater potential for increased free fall if the device towing mechanism is being operated at the time of a main rope failure.
- o The tests DID NOT address the suitability of towed devices and effectiveness of release mechanism where available.
- o Rope stretch in the back-up system is a significant issue regardless of the device used. The more rope that is in the system, the greater the back-up rope stretch. The more weight or impact force on the system, the greater the back-up rope stretch.
- o The potential for rope damage is a serious concern with toothed lock-on type devices …".

Back-up devices tested[15]

Each of the devices was demonstrated in the following ways:

- o Installation on the back-up rope
- o Method of connection to the harness
- o Function test of back-up device
- o Position of device during function test of descender
- o Position of device during descent
- o Position of device at work zone

Rope condition

A general discussion to the condition of used ropes highlighted:

> "Ropes normally become thicker with increasing wear or contamination which affect the 'normal' operation (day to day up and down use rather than emergency deployment) making the device movement harder or impossible without excessive operator handling. This may encourage operatives to pull on devices in ways that would affect their emergency performance – wrapping 'shunt cord/towing cord' around fingers or squeezing any cam loaded back-up device.

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14 Rope, when used (e.g. it has lost its lubricant, is contaminated, etc.), changes its performance characteristics (e.g. its stiffness changes, the sheath strength alters, it behaves differently in rope adjustment devices, etc.).

15 Section 4.2

> Devices that normally run unassisted … may not run, resulting in slack rope occurring above an ascending operative, or locking on (becoming partially loaded) during descent and requiring de-weighting involving short use of ascending technique.
>
> Devices with teeth function better than cam loaded devices on greasy or oily ropes.
>
> Contaminant materials may make rope damage less apparent.
>
> Cleaning problems – will cleaning products affect rope properties.
>
> Contaminants may affect the functioning of devices – may block them in open position, or render them ineffective or inoperable.
>
> Wear on devices – longevity of devices will be considerably shorter for those used on dirty, grit-contaminated ropes than those used on clean ropes.
>
> Long ropes where the combined weight of the rope below the device and the presence of contamination affects descender performance considerably.
>
> Contamination can pass on to rope protectors and other equipment and then to other ropes …".

It was concluded:

> "The overall view was that however ropes perform when new it is up to Operators to evaluate any wear or contamination as to how they affect both the rope integrity but also the performance and selection of devices used for ascent and descent etc. Toothed devices may perform better than smooth cam faced ones on oil or grease contaminated ropes …".

3 PART B – RESEARCH

This part looks at some of the research that has been undertaken to look at the equipment used within the rope access industry, including back-up devices. Concerns are raised, which need to be taken into account by manufacturers as well as those responsible for equipment selection. Research may be cited as informing any expert opinion on what is reasonably foreseeable misuse.

3.1 Health and Safety Executive (UK)

This research highlights grabbing reflex as a serious concern in a fall situation, with the consequences of the user actually grabbing the device in a fall being potentially catastrophic.

3.1.1 Investigation into items of personal protective equipment[16]

This report, undertaken for the Health and Safety Executive (HSE), notes that:

> "**6.2.14 Summary of Back-up devices**
> Despite identical test set-ups inconsistent results were the norm rather than the exception. One reason for these inconsistencies is rope type. Some devices perform better with certain makes of rope. How this relationship changes with worn rope is uncertain. For a device to be recommended as 'compatible' with a specific rope, a study would have to be made with ropes of varying age and condition …".

In a discussion about back-up devices, the following is stated:

> "The IRATA Guidelines state that the Shunt should be maintained above waist level at all times to prevent fall factors above one. The system works well and when used in accordance with the training has a good safety record. …" (6.2.1).

However, the Shunt has four potential drawbacks, some of which may be shared by all of the devices.

"A. The principal concern is that grabbing the body of the Shunt itself negates the cam action and prevents it arresting a fall. As a grabbing action is a known reflex in fall situations, this constitutes a potential danger in the Shunt's performance. However, in normal use the ability to release a loaded Shunt, by the same action, is a very useful feature. It adds to the versatility of the device and encourages the user to keep the Shunt in a safe, high position, without him/her having to worry about whether it will become unintentionally clamped to the rope and thus prevent descent when required. The question is whether users can be trained to overcome the grabbing reflex in a fall incident.

B. The second concern is the use of a cord to tow the Shunt when descending. If this is either caught in the user's equipment, or simply remains held by the user during a fall the cam action is again negated. IRATA members use various methods of holding the cord that are designed to prevent this, but it remains a significant risk.

C. The third concern is over the Shunt's relatively weak body strength. The Shunt is designed to slip when overloaded and can be used on double or single ropes. The slipping function negates the need for a strong body, as high forces should be impossible to reach. However, if the Shunt is loaded when it is only a short distance above a knot on the rope, it will be prevented

16 Contract Research Report 364/2001, Industrial rope access – Investigation into items of personal protective equipment, Lyon Equipment Ltd, www.hse.gov.uk/research/crr_pdf/2001/crr01364.pdf

from slipping by the knot and high forces could be achieved. This situation is possible in rope access, and could result in the Shunt releasing the rope at forces as low as 4 kN. The problem is exacerbated when the device is used on a single rope, as would be the case in rope access.

D. The fourth concern is the low force required to cause the Shunt to slip. While this reduces the need for a very strong body, it has one of the lowest sliding force of all the devices tested. In a dynamic loading situation the Shunt could slip well in excess of 2 metres. When combined with rope stretch, the risk of a falling operative hitting the ground or structure during the fall is greatly increased.

These problems are largely the result of the adoption of a device that was not specifically designed for the purpose. So, what are the alternatives to the Shunt? At present the alternatives can be split into two groups. The first group is work positioning devices which are used in the same manner as the Shunt. The second group replaces the work positioning-style back-up system with a fall arrest system, which consists of a free-running device that accompanies the user during changes of position. Both alternatives have their advantages and disadvantages and require devices to fulfil different requirements …".

It goes on:

> "None of the devices stood out as being the ideal back-up device. All suffered from shortfalls somewhere in their performance. However, much has been learned. While fall arrest devices can work well, and may be applicable to many situations, they are not suitable for rope access without modification to allow them to remain in position on the rope. (Such modification could, for example, be by the application of a spring, or additional karabiner loading as shown by two of the devices tested). Correct operation of a back-up device, as recommended by the IRATA 'Guidelines on the use of rope access methods for industrial purposes', results in a very safe system where the possibility of a fall factor greater than 1 is eliminated. This has allowed trained operatives to use devices whose performance and strength may not be ideal, effectively and safely. The shortfalls of the Petzl Shunt have been clearly seen and the industry should now be developing devices which fulfil the requirements discussed above. One serious concern remaining is the 'grabbing' reflex, of the operator, in a fall situation. With many devices there is a good chance that performance will be impaired if anything is in contact with the device. The consequences of the user actually grabbing the device in a fall are potentially catastrophic: many devices will be completely disabled by this action. Ideally this should be designed out of the device. However, at present all devices suffer to some degree from this problem. Training users to overcome this reflex is essential, at least until a device is available which will pull down the rope when required, but remain secure if grabbed in panic. …" (6.2.13).

3.1.2 Survivable impact forces on human body (2003)[17]

This research work was undertaken to determine the scope for increasing impact forces for those working at low levels, e.g. roofs. It looked at selection of 6kN as the maximum arrest force and recommends that attention be given to body weights outwith the 80 kg to 100 kg person.

The object of this study was:

> "… to determine if it is medically supportable to develop energy absorbing devices with arrest force greater than the present CEN standard 6kN maximum advised for wearers of industrial full body harnesses …".

[17] Survivable impact forces on human body constrained by full body harness, HSL/2003/09, www.hse.gov.uk/research/hsl_pdf/2003/hsl03-09.pdf

It was noted that:

> "… Reduction of fall height entails increase of fall arrest forces. A major feature of the study was the gathering of information on impact tolerance levels on the human body, particularly seat-to-head data …".

Part of the Executive Summary states:

> "… The literature is not sympathetic to the notion of increasing present levels of arrest force on wearers of full body harnesses. A deceleration of 12G is considered survivable in a parachute harness, i.e. a harness with torso enclosing straps and shoulder straps. For such harnesses the NASA/AGARD[18] researches indicate a 5% injury risk at 12.1G, but the differing posture, physical fitness levels, harness attachment location, 'wearer comfort' and other factors have influenced the advisability of 6G as a maximum for users of industrial harnesses.
>
> The study includes easily understood mathematics which show that efforts to reduce arrest distance by increasing the arrest force introduce a law of 'diminishing returns'. It concludes that the present 6 kN limit (EN standards) is a wise choice for body weights in the range 80 kg to 100 kg. But it is recommended herein that 4 kN maximum arrest force is more suitable for body weights in the range 50 kg to 80 kg, and 8 kN max would be suitable for body weights in the range 100 kg to 140 kg. Strong recommendations are made that UK and CEN standards bodies should seriously pursue this proposal. …".

The background notes (1.1):

> "… Until the introduction of European Standards (EN standards) in 1993, the accepted UK standard for harnesses and associated equipment was BS 1397. From its inception BS 1397: 1947 "Specification for safety belts and harnesses", and its revisions over the years 1956, 1967 and 1979, advised performance norms for harnesses and associated equipment where the structural anchorage point was always above the user. The worst case was considered to be when the anchor point was horizontally in line with the attachment point of harness and lanyard (i.e. it was considered that the worker would not fall further than the length of the lanyard - 2 metres maximum – fall factor 1.0). BS 1397: 1979 put a limit of 10 kN on the arrest force, when tested with a 100 kg articulated dummy on a fall of 2 metres. …".

In looking at the events leading to CEN's selection of 6kN as the maximum arrest force, the report states (3.1):

> As described in the introduction, 1947 saw the beginning (in the UK) of performance testing of industrial "safety belts" and harnesses to BS 1397. Until 1979 these tests were mainly "strength tests", static and dynamic, to ensure the structural integrity of harnesses and thus to protect the wearer from falling to the ground or floor. There was no requirement to test for arrest forces.
>
> By the 1970s there was a beginning of access to the information learned from military and aerospace studies. In the UK, the source of such information was the RAF Institute of Aviation Medicine, Farnborough *(Beeton, Ernsting, Glaister and Reader).* The 1979 version of BS 1397 reflected this growing access in its test specification of 10G maximum for pole belts, 5G maximum for general purpose safety belts and chest harnesses, and 10G for general purpose safety harnesses. A special provision of 12.5G maximum, with full body harness, was made for coalmine riggers who had a preference for chain lanyards. All of these 1979 version tests were carried out with an "articulated anthropometric dummy" of 100 kg. It is noteworthy that only full body harnesses are now considered suitable in fall-risk situations. …

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18 NASA: Advisory Group for Aeronautical Research and Development

> The literature acknowledged that the uninjured, undebilitated, voluntary human exposures shown were with physically fit humans who were secured at the seat and shoulders. The available medical and physiological information related almost exclusively to studies with military personnel. Other data and medical/physiological opinion indicated that 12 kN was the “maximum of tolerance” for fit men at parachute canopy opening *(Amphoux [2], Beeton [6], Delahaye [13], Hearon & Brinkley [21], Kazarian [27], Snyder [40], Stapp [43]). ….*
>
> These factors were accepted by the technical committee CEN/TC160, and 6 kN was adopted as the maximum arrest force for fall-protection devices used with industrial full-body harnesses. The same norms have since been adopted for the relevant ISO standards.
>
> **3.2 U.S.A. and Canadian Requirements**
> To date, the US Occupational Safety and Health Authority (OSHA) requirement, the American National Standard Z359 and the Canadian Ontario Ministry of Labour requirement for fall protection all provide for 6ft, fall factor 1.0 falls. All three permit a maximum arrest force of 8 kN. …”.

In some observations on lanyard, energy absorber and harness extension in a fall:

> “The author has long been perplexed that the industry supplies only one solution for a multivariable problem. The standards all employ a 100kg mass on dynamic testing. This does not take account of the huge range of body weight of workers in the field, nominally 50 kg to 140 kg (7.8 st to 22 st), possibly greater … The author strongly recommends that attention be given to body weights outwith the 80 kg to 100 kg person. Designers should ensure that devices are capable of absorbing the potential energy of the heaviest recommended user in each range …”.

3.1.3 Other Reports (2002)

Other research reports, that consider *impact tolerability*, are:

- Harness suspension: review and evaluation of existing information
  Contract Research Report 451/2002[19]
- Analysis and evaluation of different types of test surrogate employed in the dynamic performance testing of fall-arrest equipment
  Contract Research Report 411/2002[20].

19 www.hse.gov.uk/research/crr_pdf/2002/crr02451.pdf
20 www.hse.gov.uk/research/crr_pdf/2002/crr02411.pdf

3.2 Research by Others

Testing on used rope has identified that the rope/device combination plays a significant role in how back-up devices perform.

3.2.1 Rope access equipment testing: The back-up safety system - Jan Holan and Steve Beason (2002)[21]

In August 2002, The Bureau of Reclamation and Ropeworks, Inc. conducted testing of industrial rope access equipment used in the back-up safety system. One-person and two-person loads were considered. This research addresses some unanswered questions raised by an extensive 2001 study conducted by Lyon Equipment Ltd. for the United Kingdom's Health and Safety Executive.

The goal of the study was to:

> "… test rope access equipment commonly used in the back-up safety system …".

The report states:

> "We were most interested in testing the "back-up device" used in a "self-belay" system. We also tested a few belay devices that might be used by a co-worker to provide an "attended belay" for regular work activities, or in a rescue situation. All of the belay devices were also (or mainly) designed to function as descenders. We tested a few other devices, techniques, and variables in a non-systematic manner to explore some curiosities. Although this additional data was not necessarily statistically valid, the results are informative nonetheless. While we considered existing test standards, our test methods were designed to replicate conditions found in the field. We were less interested in seeing if a particular device met a specific standard, rather we wanted to make sure that it worked effectively in the manner that it was commonly used in the field …".

It was reported that back-up devices used in rope access generally fall into two categories, ascender-type rope grabs and self-trailing rope grabs (mobile fall arrestors):

Ascender-type back-up devices	**Mobile Fall Arrestors (ANSI-labelled)**
Petzl Shunt	MIO Rope Grab
Petzl Rescucender	PMI Arrestor
PMI Progressor	Troll/Yates Rocker

With respect to dynamic testing it is noted that:

> "Rope grabs designed for fall arrest should not slip more than 54 inches (138 cm) and must yield a maximum impact force of no greater than 8 kN (1760 lbsF) according to ANSI Z359.1. CSA standards also call for a maximum allowable impact force of 8 kN while CE requirements limit impact force to 6 kN …".

Also:

> "The Shunt will not conform to the requirements of the U.S. fall protection standards because of it has a relatively weak body, it can be defeated by the user, and it does not self-trail. However, at this point the Shunt should still provide a safe option for a rope access technician provided it is paired with the correct rope diameter and proper operator training …".

The general conclusions include the following:

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21 www.irata.org/pdf%20downloads/Back-up%20system%20Testing%20J%20Holan%20S%20Beason.pdf

> "One of our most important conclusions is that the rope and device combination is important. Diameter of rope, and to a lesser extent the rope construction, seemed to play a significant roll (sic) in how the devices performed in the given tests …".

and

> "We have been reminded that just because a piece of equipment meets a standard it doesn't mean it will work in every field condition, or perhaps even in most field conditions. Keep an open mind to techniques and equipment that have been "proven" unsafe. The best way to make sure that your equipment will function the way you intend is to test it yourself …".

This appears to be the first time that a researcher has looked at and published the findings of testing on old rope.

3.2.2 BARA: Test of back-up tools for rope access on loaded ropes (2012)[22] [23]

This report, with video links is available at www.bara.dk/RABUtest/rabu.htm. The following extracts outline some testing undertaken to test back-up devices on loaded ropes, raising a number of concerns:

> **"Introduction: General background**
>
> During the last year, a number of our members in BARA have reported observations and incidents which has led to doubts and even worries, regarding the efficiency of the involved back-up tools for rope access, when the rope, on which the back-up tools were placed, was being loaded with a person's weight (as it would be during a pick-off rescue).
>
> These concerns led to improvised testings on the PRAT®[24]- annual rope access meeting and workshops on the 15th and 23rd of November, 2012.
>
> Many of the rope access companies in our trade association had already shifted to or were considering shifting to the Red, as the Shunt no longer seemed an option, hence the letter from Petzl from January 2012 and the letters from the SPRAT Board of Directors from April and June 2012, so it seemed natural, that the preliminary tests were done on the ISC RED.
>
> The tests showed that the ISC Red might not hold on a loaded rope.
>
> This led to a decision to do further tests on a variety of back-up tools for rope access under similar conditions (on a rope, loaded with the weight of a person) and these tests were then done on the 13th of December, 2012 …".

The conclusions stated:

> "We were quite surprised to find, that many of the tools, which are being used widely in the rope access industry, may be unsafe when on a loaded rope (e.g. during a pick-off rescue).
>
> This calls for further investigation.
>
> … It is worth noticing, that the possible combinations of rope and tool may play a role in this. We only had the opportunity to test the tools on one kind of rope, but other brands, materials, constructions etc. may change the outcome of similar tests.

22 http://www.bara.dk/RABUtest/RABUtest.pdf
23 BARA: Brancheforeningen for Autoriseret Rope Access
24 http://www.prat.cc/

However, as ropes change all the time, we do think that back-up tools should be working on in principle all ropes within the given parameters of i.e. diameter …".

Further discussion includes:

"Many of the above tools may be working perfectly in a standard rope access work situation.

However, if a pick-off rescue might become necessary, this test indicates that the back-up tool of either the casualty or the rescuer (depending on whether or not the rescuer starts from the top or from below) might not be working as soon as the rescuer gets on the rope.

It is true that accidents in rope access rarely happens and that a rescue thus is equally rare.

However, if the rescue plan requires a pick-off rescue, it is worth knowing, that this might mean that the back-up tool may not be working during the part of the rescue, where the rescuer is on the same rope as the casualty's back-up device.

The problem of back-up tools potentially not working properly on loaded ropes is particularly relevant for rope access training, where pick-off rescues are performed regularly in every internationally known rope access system.

In a standard rope access training session, pick-off rescues are trained repeatedly, and will certainly have to be demonstrated at the evaluation/certification session.

The above tests show that we should pay attention to how we do pick-off rescues in the future, including which tools we use, when we do them …".

A final discussion topic states:

"It might be worth asking the manufacturers of back-up devices to be testing their tools on a rope, tensioned by a certain weight, e.g. 100 kg and then passing on the information about how the back-up tool performed along with the other product information …".

3.2.3 Testing Videos

A number of back-up device drop test videos are available online. See Annex 5.

3.3 Towed Back-up Devices

Towed back-up devices are those that rely on the operator to change the position of the device on the ropes. The most significant potential drawback is the possibility that the device will not operate in the event of a fall because the user will not behave in a predictable way.

3.3.1 Pinch strength

A device that uses a cord introduces consideration for the issue of 'pinch strength'. Mathiowetz et al (1985)[25] presented the following research data:

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[25] Mathiowetz V, Kashman N, Volland G, Weber K, Dowe M, Rogers S: Grip and pinch strength: normative data for adults. Arch Phys Med Rehabil 66:69-72, 1985 (http://www.fcesoftware.com/images/5_Grip_and_Pinch_Norms.pdf)

Male (30 to 34), mean (pounds), Right hand

	pounds	*converting to kg*
Tip pinch	17.6	7.98
Key pinch	26.6	11.93
Palmar pinch	24.7	11.20

where:

Tip pinch is:	thumb top to index fingertip
Key pinch is:	thumb pad to lateral aspect of middle phalanx of index finger
Palmar pinch:	thumb pad to pads of index and middle fingers

Similar work by Angst et al[26] gives the following data:

Male (30 to 34), mean, Dominant hand

	kg
Key pinch	9.9

Predicators were determined as: sex, height, age, weight and occupation.

3.3.2 Reaction time

One of the most notable issues relating to the use of towed back-up devices that require a human action is the uncertainty of a person reacting quickly enough. When designing a device that uses a cord that requires releasing it may be necessary to consider 'reaction time'. A literature review by Kosinski[27] states:

> "For about 120 years, the accepted figures for mean simple reaction times for college-age individuals have been about 190 ms (0.19 sec) for light stimuli and about 160 ms for sound stimuli (Galton, 1899; Fieandt et al., 1956; Welford, 1980; Brebner and Welford, 1980). However, Eckner et al. (2010) reported that the reaction times of NCAA football players averaged 0.203 sec when determined with a simple falling meter stick but 0.268 sec when measured with a computer. Reaction times measured at Clemson are usually closer to 0.268 sec for a simple visual stimulus …".

The type of reaction time experiment, the type of stimulus, and the stimulus intensity are all stated to be basic features in any reaction time experiment.

However, there are many factors affecting reaction time. These include:

- arousal (state of attention);
- relevance of stimulus to survival;
- age;
- gender;
- left versus right hand;
- direct versus peripheral vision;
- practice and errors; fatigue;
- fasting; distraction;
- warnings of impending stimuli;
- alcohol;
- order of presentation;
- breathing cycle;
- finger tremors;

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26 Prediction of grip and key pinch strength in 978 healthy subjects, Angst et al. BMC Musculoskeletal Disorders 2010, 11:94 (http://www.biomedcentral.com/1471-2474/11/94)

27 A literature review on reaction time by Robert J. Kosinski, Clemson University (http://biae.clemson.edu/bpc/bp/Lab/110/reaction.htm), Last updated: September 2012

- attentional blink;
- affective priming;
- personality type;
- exercise;
- punishment, stress and threats;
- stimulant drugs;
- depressant drugs;
- intelligence;
- learning disorders;
- brain injury and illness.

In the context of back-up devices it is, therefore, difficult to assess how a user may respond to the use of towed back-up device that requires a human action.

4 PART C - PRODUCT DEVELOPMENT

This part considers some of the legal aspects that apply to product developers, including the concept of reasonably foreseeable misuse. Also included is a critique of BS EN 12841: 2006, that concludes that the standard does not contain test requirements and methodology that reflect actual circumstances of use. An overview of the CE marking process is presented, with the view that a CE mark is only one of the factors involved in an equipment selection process.

4.1 Fit for purpose

When you buy something, consumer law says the item must be 'fit for purpose'[28]. As well as being fit for their normal purpose goods must also be fit for any specific purpose that the seller told you they would be fit for. The law which gives you this right is called the Sale of Goods Act[29].

In most cases it will be obvious what the purpose of the goods is. If goods aren't able to carry out their normal functions for any reason, they are not fit for purpose. The Sale of Goods Act 1979[30] says that goods that are not fit for their normal purpose are not of satisfactory quality and you may have the right to return them to the seller and get a refund.

4.2 Reasonably foreseeable misuse

A concept often debated amongst those involved in the design and use of back-up devices is that of 'reasonably foreseeable misuse'. It is simply explained, albeit in the context of research into the safety of stepladders, in a research report published by Loughborough University[31]:

> "… This is normally termed 'reasonably foreseeable misuse'. A popular example is that of a flat-bladed screwdriver. As a tool, its primary intention is to insert and remove screws, but virtually any user asked will report that it is also used to open tins of paint. This use must then be considered 'reasonably foreseeable'.
>
> There is some skill necessary in defining the borders between foreseeable misuse and abuse, and manufacturers may require outside expertise in order to achieve the necessary balance.
>
> Again, in respect of the screwdriver, opening tins of paint may be foreseeable misuse, whereas use as a chisel (or, worse, use as a weapon) may be considered abuse.
>
> This distinction has important implications for a manufacturer. Current legislation requires that their products must be safe in conditions of normal use or reasonably foreseeable misuse …".

The report concludes:

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28 Citizens Advice Bureau (CAB), www.adviceguide.org.uk/nireland/consumer_ni/consumer_common_problems_with_products_e/faulty_goods_e/what_is_meant_by_goods_not_fit_for_purpose.htm (Accessed 2nd June 2013)

29 http://nebosh-revision.blogspot.co.uk/2011/04/case-law-edwards-v-national-coal-board.html

30 http://www.legislation.gov.uk/ukpga/1979/54

31 Ergonomics evaluation into the safety of stepladders, Literature and standards review - Phase 1, Contract Research Report 418/2002 (HSE), www.hse.gov.uk/research/crr_pdf/2002/crr02418.pdf

> "… This means that the manufacturer must appraise the range of tasks that will be undertaken with their product, and design it such that it presents the minimum of risks in these situations. This precludes product manufacturers from applying numerous warnings to their products advising users not to undertake activities, which they quite patently will do. Failure to enact these responsibilities can culminate in the manufacturer facing criminal prosecution in addition to civil liability claims …".

People use stepladders side on and stretch out too far, irrespective of what is stated in the user instructions. It is similarly possible to identify reasonably foreseeable mis-use in respect of back-up devices. Despite the care taken to produce user instructions, it must be questionable as to how often they are read in detail. For product designers, 'beware of the user'.

4.3 A critique of BS EN 12841: 2006[32]

A report prepared externally for heightec is harsh in its criticism of EN 12841: 2006:

> "When the original draft version of EN 12841 was first released for public comment, it received significant criticism, particularly in regard to its test methodology. Some commentators could not understand why an existing standard, BS EN 353-2, (guided type fall-arresters on a flexible anchor line), could not be used to cover Class A devices. …
>
> In order to try and get around the normal requirements for fall-arrest devices, it would appear that the final (2006) published version of EN 12841 has attempted to use confusing and evasive language, and has tried not to call the Class A device a fall-arrest device, when in actual fact it is fundamentally a fall-arrest device. This, together with poorly thought-out test requirements and inadequate test methodology, has produced a fundamentally-flawed standard.
>
> Particular examples of this confusing language can be found in various places within the document:
>
> *"Rope adjustment devices as specified are not suitable for use in a fall-arrest system"*. Here the scope is at odds with what the device is supposed to do, according to the remainder of the standard.
>
> Also note clause A.1 in the informative annex A: *"It is important for potential users to be aware that the test methods described in this European Standard do not describe the actual way of use"*. If the test methods do not reflect the way that the devices are used within the rope access system, what is the point of specifying the test methods in the first place, when test methods are supposed to recreate the circumstances of actual use?
>
> Furthermore in the requirements for instructions for use: *"advice that this equipment is not suitable for use in a fall-arrest system unless it also conforms to other relevant standards"*. This is an amazing statement given that the device plainly acts as a fall-arrester in a fall-arrest system. It appears from this that the device cannot be used in a system as described in the standard itself.

A number of omissions and criticisms against test criteria and methods within the standard are made, with a conclusion that:

> "Overall the standard lacks engineering input and is full of confusing statements. It requires a comprehensive revision …".

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32 Critique of BS EN 12841: 2006 - rope adjustment device standard for rope access systems (January 2013); Not published

Opinion is expressed that:

> "There are also some serious omissions in the requirements for marking and instructions for use. These relate to such issues as: connecting lanyard length, single and double user scenarios, anchor strength requirements, free space beneath the user particularly where distances between user and anchor are significant, temperature range that the device can be used in, dangers of sharp edges, rope protection with a known protective ability, and removal of equipment from use after sustaining a load from a fall. …".

In conclusion:

> "… the main criticism of the standard is that it does not contain test requirements and methodology that reflects actual circumstances of use and particularly the load cases where two users may be connected to the same device. In some cases the test requirements are insufficient, which results in a device that can be released into the market place and which may not meet protection expectations in an emergency situation. In other cases the tests are far too onerous, making the achieving of a pass result unjustifiably difficult. …".

4.4 CE marking[33]

It is essential not to use CE marking as the sole criterion for purchasing equipment. It is often thought that the CE mark means that the equipment will be suitable for the particular task for which it is being purchased.

This is not necessarily the case, as the testing specified in the relevant European standard is often limited to checking the most important parameters under laboratory conditions and therefore might not cover the specific circumstances of use. Therefore, ensuring that the equipment has a CE mark is only one of the factors involved in the selection process.

When it is planned to use CE marking as a criterion for purchasing equipment, it is essential to ensure that the marking is for goods appropriate to the intended use.

CE marking is mandatory on many different types of product, not just personal protective equipment (PPE). For PPE, there are three different categories, ranging from simple items like protective work gloves (category I) to category III equipment for protection against mortal danger (e.g. harnesses). Most equipment for fall protection is category III.

For PPE category III, CE marking indicates that the product has been independently type tested and meets the basic health and safety requirements of the Personal Protective Equipment Directive (89/686/EEC) and the Personal Protective Equipment Regulations 2002.

This is certified by an organization, approved by the government, known as a notified body. A notified body also monitors the quality of production, either by random but regular inspections of the manufacturer's quality system (e.g. to BS EN ISO 9001) or by carrying out batch tests. The usual way for manufacturers to ensure that their products meet the requirements of the Personal Protective Equipment Regulations is to have their products tested to a recognized standard, although this is not the only way.

The alternative is for equipment to be CE marked to the Personal Protective Equipment Directive (89/686/EEC) via the technical file route as defined in the directive. Category III PPE … will always have a four-digit numerical code attached to the CE mark to identify the relevant notified body.

Further details are provided in *Personal Protective Equipment: Guidance notes on UK Regulations*[34], published by the Department of Trade and Industry (DTI).

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33 Extract from BS 8437: 2005

5 PART D – LEGAL

This part looks at the regulatory framework, as well as some of the legal terms contained within legislation, e.g. ‘reasonably practicable’, ‘suitable and sufficient’, etc. A distinction should be made between criminal and civil litigation, with the latter requiring a lower burden of proof. Relevant legal cases are summarised. Whether you are an employer, employee or product manufacturer, the Courtroom is not a place to be rehearsing why something wasn’t done, or something could have been done better.

5.1 Regulatory Framework (UK)

This part will look at the UK regulatory framework which, from Act through to Guidance, adopts an hierarchical approach. The primary requirement is to manage workplace risk; this should be at the heart of all decision-making.

5.1.1 Acts, Regulations, Guidance and ACoPs[35]

The basis of health and safety law is the Health and Safety at Work etc. Act 1974 (HSWA, the Act). An Act is primary law, enacted by parliament. The Act sets out the general duties that employers have towards employees and members of the public, and that employees have to themselves and to each other. These duties are qualified in the Act by the principle of “so far as is reasonably practicable”.

Regulations are secondary law, approved by a Minister under powers made under the Act. Regulations contain more detail, so need to be easier to change. The Act, and the general duties under, for example, the Management of Health and Safety at Work Regulations 1999 are ‘goal setting’ and leave employers freedom to decide how to control risks that they identify. Regulations identify some risks specifically and set out specific action that must be taken. Sometimes, these requirements are absolute, i.e. there is a need to do something without qualification.

An Approved Code of Practice (ACoP) offers practical examples of good practice. It gives advice on how to comply with the law by, for example, providing a guide to what is ‘reasonably practicable’. For example, if regulations use words like ‘suitable and sufficient’, an ACoP can illustrate what this requires in particular circumstances. An ACoP has a special legal status. If employers are prosecuted for a breach of health and safety law, and it is proved that they have not followed the relevant provisions of the ACoP, a court can find them at fault unless they can show that they have complied with the law in some other way.

Guidance is available on a range of subjects. Some is specific to the health and safety problems of an industry or of a particular process used in a number of industries. The main purpose of guidance is to interpret what the law says, to help people comply with the law and to give technical advice. Following guidance is not compulsory and employers are free to take other action, but if they do follow guidance they will normally be doing enough to comply with the law.

5.1.2 Risk and hazard

In everyday language, ‘risk’ refers to danger, peril, and exposure to loss, injury or destruction. In this Review a ‘hazard’ is something with the potential to cause harm. The ‘risk’ arising from that hazard depends on the probability that the harm will occur, combined with the severity of the consequences.

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34 DEPARTMENT OF TRADE AND INDUSTRY. Personal Protective Equipment: Guidance notes on UK Regulations, www.bis.gov.uk/files/file11263.pdf

35 www.hse.gov.uk/pubns/hsc13.pdf

5.1.3 Reasonably practicable[36]

Every employer needs to know whether a step is “reasonably practicable” in order to avoid potential criminal liability under Section 2 and Section 3 of the Health and Safety at Work etc. Act 1974. Since the Act was introduced in 1974, the question of what steps are reasonably practicable has consequently been under scrutiny.

Reasonable practicability is a concept with a history extending well beyond 1974 and the Act. The judicial test for what is reasonably practicable most commonly cited in regulatory guidance has (for six decades) been a comment of Asquith J in Edwards v National Coal Board (1949)[37]:

> “a computation must be made by the owner in which the quantum of risk is placed on the one scale and the sacrifice involved in the measures necessary for averting the risk… is placed on the other and if there is a gross disproportion between them – the risk being insignificant in relation the sacrifice – the defendants discharge the onus on them.”

In essence, making sure that a risk has been reduced ‘as low as reasonably practicable’ is about weighing the risk against the sacrifice needed to further reduce it. The decision is loaded in favour of health and safety as the presumption is that the duty-holder, i.e. the employer, should implement the risk reduction measure. To avoid having to make this 'sacrifice', the duty-holder must be able to show that it would be grossly disproportionate[38] to the benefits of risk reduction that would be achieved. Thus, the principle behind the process is not one of balancing the costs and benefits of measures but, rather, of adopting measures except where they are ruled out because they involve grossly disproportionate sacrifices.

5.1.4 Practicable

The words ‘reasonably practicable’ should not be confused with ‘practicable’. In a legal context, ‘practicable’ infers a statutory obligation that has to be met if, in the light of current knowledge, it is feasible (irrespective of cost or difficulty). Put at its simplest, ‘practicable’ means ‘if it can be done, it must be done’.

5.1.5 Burden of proof

In civil cases the burden of proof is based upon ‘the balance of probabilities’ and not 'beyond all reasonable doubt’ as in criminal cases[39]. In other words is it 'likely' that the evidence can be relied upon. This is to do with the fact that the consequences for the losing party, whilst they may be dire, are not as serious as a criminal conviction which carries the stigma that goes with it and the risk of a custodial sentence.

Where a duty-holder is required to do what is ‘reasonably practicable’ or ‘practicable’ to achieve a safe system of work, Section 40 of the Act provides that the burden is on the defendant to satisfy the court that it was not practicable or reasonably practicable to do more to control the risk than was in fact done. This is often referred to as a ‘reverse burden’, because it reverses the normal situation that the prosecution must prove the facts beyond reasonable doubt.

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36 http://www.hse.gov.uk/risk/theory/alarpglance.htm

37 http://nebosh-revision.blogspot.co.uk/2011/04/case-law-edwards-v-national-coal-board.html

38 Tangerines and Bakers – Judicial clarification of Gross Disproportion, August 2011, Burges Salmon Briefing, http://www.burges-salmon.com/Practices/environment_and_health_and_safety/health_and_safety/Publications/Tangerines_and_Bakers_Judicial_clarification_of_Gross_Disproportion.pdf

39 www.lawmentor.co.uk/glossary/T/the-balance-of-probabilities/

5.1.6 Liability under civil law and duty of care

As well as criminal law, those who are responsible for harm to others may be sued for damages under civil law. Liability may arise from the terms of a contract, or may exist irrespective of contract under the 'duty of care' principle[40].

The law of negligence condemns as negligent any act or omission that falls short of a standard to be expected of 'the reasonable man'. The application of this test by the courts depends on the type of case. In a clinical negligence action the standard was defined in the 'Bolam test' (1957)[41]. This set out the test used when a judge is considering whether or not a doctor has been negligent, and has subsequently been extended to other professions.

The case held that a doctor is not in breach of the duty of care, "if he has acted in accordance with a practice accepted as proper by a responsible body of medical men skilled in that particular art". The practical effect of the test is that a judge will hear evidence from experts in the appropriate speciality and must decide whether the actions of the doctor were proper. Often, there are several acceptable ways of doing something and compliance with any of these will mean that there was no breach of duty of care. Experts often disagree over these issues and the judge must decide whose evidence is to be preferred.

It is important that anyone reviewing a case as an expert, or giving an informal view, understands the Bolam test. The fact that the person giving an opinion would not have done things in the same way does not automatically mean that there was a breach of duty of care. The actions taken may be acceptable to 'a responsible body of opinion' and research (such as a literature search) may be needed to check the position. When considering whether one owes a duty of care, up to date information is essential, as case law evolves over time.

5.1.7 Suitable and sufficient

The Management of Health and Safety at Work Regulations 1999[42] require[43] that, "Every employer shall make a *suitable and sufficient* assessment of risks to the health and safety of his employees to which they are exposed whilst they are at work …".

'Suitable and sufficient' is not defined in the Regulations. In practice it means the risk assessment should do the following[44]:

> "(a) The risk assessment should identify the risks arising from or in connection with work. The level of detail in a risk assessment should be proportionate to the risk. Once the risks are assessed and taken into account, insignificant risks can usually be ignored, as can risks arising from routine activities associated with life in general, unless the work activity compounds or significantly alters those risks. The level of risk arising from the work activity should determine the degree of sophistication of the risk assessment.

40 Generally, a duty of care arises where one individual or group undertakes an activity which could reasonably harm another, either physically, mentally, or economically. This includes common activities such as driving (where physical injury may occur), as well as specialised activities such as dispensing reliant economic advice (where economic loss may occur). Where an individual has not created a situation which may cause harm, no duty of care exists to warn others of dangerous situations or prevent harm occurring to them; such acts are known as pure omissions, and liability may only arise where a prior special relationship exists to necessitate them (http://en.wikipedia.org/wiki/Duty_of_care_in_English_law).

41 Bolam v Friern Hospital Management Committee, High Court, [1957] 1 WLR 583

42 Management of health and safety at work, Management of Health and Safety at Work Regulations 1999, Approved Code of Practice & guidance, http://www.hse.gov.uk/pubns/priced/l21.pdf

43 Regulation 3 Risk assessment

44 Paragraph 13

(b) Employers and the self-employed are expected to take reasonable steps to help themselves identify risks, e.g. by looking at appropriate sources of information, such as relevant legislation, appropriate guidance, supplier manuals and manufacturers' instructions and reading trade press, or seeking advice from competent sources. They should also look at and use relevant examples of good practice from within their industry. The risk assessment should include only what an employer or self-employed person could reasonably be expected to know; they would not be expected to anticipate risks that were not foreseeable …".

A risk assessment should[45] ensure the significant risks and hazards are addressed and ensure all aspects of the work activity are reviewed, including routine and non-routine activities. It should be systematic in identifying hazards and looking at risks, whether one risk assessment covers the whole activity or the assessment is divided up. An employer should always adopt a structured approach to risk assessment to ensure all significant risks or hazards are addressed.

The regulation also provides that employers with *five or more* employees must record the *significant findings* of their risk assessment[46]. This record should represent an effective statement of hazards and risks which then leads management to take the relevant actions to protect health and safety.

5.2 Law Enforcement and Legal Cases

This part looks at UK law enforcement for occupational safety and health. There are number of pertinent legal opinions relevant to those considering how to manage risk.

5.2.1 Law enforcement

In the UK, the Health and Safety Executive (HSE)[47] and local government are generally the enforcing authorities for health and safety regulation. The HSE's mission is to protect people's health and safety by ensuring risks in a changing workplace are properly controlled.

The consequence of failure has increased in profile over recent years. Since the Corporate Manslaughter and Corporate Homicide Act 2007[48], companies and organisations can be found guilty of corporate manslaughter as a result of serious management failures resulting in a gross breach of a duty of care. In addition, the Health and Safety (Offences) Act 2008[49] [50] has increased penalties and provides courts with greater sentencing powers for those who flout health and safety legislation.

5.2.2 Court of Appeal (Criminal Division)

The Health and Safety at Work etc. Act 1974 has been the bedrock of workplace health and safety law in the UK[51]. Over the years, a number of health and safety cases have made it difficult to clearly interpret long-established principles within the Act. However, in the case of R v Tangerine Confectionery Ltd and Veolia ES (UK) Ltd [2011] [52] , the Court of Appeal gave guidance on the effects of the Health and Safety at Work etc. Act 1974 s.2 and s.3.

45 Paragraph 18
46 Paragraph 23
47 www.hse.gov.uk/
48 www.legislation.gov.uk/ukpga/2007/19/contents
49 www.legislation.gov.uk/ukpga/2008/20/contents
50 www.hilldickinson.com/pdf
51 www.inhouselawyer.co.uk/index.php/fraud-and-corporate-crime/9665-the-future-is-bright-the-future-is-tangerine
52 [2011] EWCA Crim 2015, 19 August 2011, http://www.crownofficechambers.com/assets/docs/news/tangerine_judgment.pdf

LJ Hughes stated that:

> "Foreseeability of risk (strictly foreseeability of danger) is indeed relevant to the question whether a risk to safety exists … None of this, however, means that in a prosecution under either section it is incumbent on the Crown to prove that the accident which occurred was foreseeable. That would convert the sections into ones creating offences of failing to take reasonable care to avoid a specific incident …".

LJ Hughes further commented that:

> "The sections do not command an enquiry into the likelihood (or foreseeability) of the events which have in fact occurred. They command an enquiry into the possibility of injury. They are not limited, in the risks to which they apply, to risks which are obvious. They impose, in effect, a duty on employers to think deliberately about things which are not obvious …".

In the context of back-up devices a thorough approach should be taken by employers and equipment manufacturers to address the possibility of injury and think about things that are not obvious.

5.2.3 Supreme Court

Whether the safety of a place of work is an absolute and unchanging concept or a relative concept is considered in the case of Baker v Quantum Clothing Group[53]. According to Lord Mance, in the Supreme Court:

> "Whether a place is safe involves a judgment, one which is objectively assessed of course, but by reference to the knowledge and standards of the time …" (Para. 64).

Lord Dyson expressed himself in similar terms. He observed:

> "Opinions as to what is safe may vary over time as, with developing knowledge, changes occur to the standards that are expected to be followed. I do not, therefore, agree with Smith LJ (Para. 78) that what is objectively safe cannot change with time. Standards of safety are influenced by the opinion of the reasonable person and forseeability plays a part in the forming of that opinion …" (Para. 108).

Lord Mance notes, from Taylor v Coalite Oils & Chemicals Ltd.[54], that:

> "'Safe' is the converse of 'dangerous'. A working place is 'safe' if there is nothing there which might be a reasonably foreseeable cause of injury to anyone working there, acting in a way in which a human being may reasonably be expected to act, in circumstances which may reasonably be expected to occur …" (Para. 71).

And that, from Robb v Salamis (M & I) Ltd.[55]:

> "… "The obligation is to anticipate situations which may give rise to accidents" …" (Para. 72).

In the context of back-up devices, an employer and equipment manufacturer must take account of things that are reasonably foreseeable. Developing knowledge means that opinion as to what is safe will vary over time. The lessons learnt within industry should be shared and acted upon, not ignored.

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53 Hilary Term [2011] UKSC 17, On appeal from: [2009] EWCA Civ 499, http://www.supremecourt.gov.uk/decided-cases/docs/UKSC_2009_0108_Judgment.pdf

54 Taylor v Coalite Oils & Chemicals Ltd (1967) 3 KIR 315

55 Robb v Salamis (M & I) Ltd [2006] UKHL 56; [2007] ICR 175,

6 PART E - EMPLOYERS

This part considers the legislation directly relevant to work at height and is aimed at company directors, managers and supervisors. Other legislation is also summarised.

6.1 Work at height legislation relevant to rope access

Within the UK's regulatory regime there are a number of relevant Directives, Regulations, etc.

6.1.1 Temporary Work at Height Directive (2001/45/EC)[56]

European Directive 2001/45/EC (sometimes referred to as the 'Temporary Work at Height Directive') sets *minimum* safety and health requirements for the use of work equipment by workers at work. Employers who intend to have temporary work carried out at a height:

> "… must select equipment affording adequate protection against the risks of falls from a height …".

Ladders, scaffolding and ropes, "… are the equipment most commonly used in performing temporary work at a height …". The selection and use of equipment should be, "… accompanied by specific training and supplementary investigations where appropriate".

The Annex[57] contains provisions concerning the use of work equipment provided for temporary work at a height. There are specific provisions regarding the use of rope access and positioning techniques[58], including:

(b) workers must be provided with and use an appropriate harness and be connected by it to the security rope;

(c) … The security rope must be equipped with a mobile fall prevention system which follows the movements of the worker;

6.1.2 Work at Height Regulations 2005[59]

The Work at Height Regulations 2005[60] implement Directive 2001/45/EC. Under the heading *Requirements for particular work equipment* the Regulations require that:

> "… Every employer shall ensure that … a personal fall protection system[61], Part 1 of Schedule 5 and … in the case of rope access and positioning techniques, Part 3 of Schedule 5 … are complied with"[62].

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56 Directive 2001/45/EC of the European Parliament and of the Council of 27 June 2001 amending Council Directive 89/655/EEC concerning the minimum safety and health requirements for the use of work equipment by workers at work (second individual Directive within the meaning of Article 16(1) of Directive 89/391/EEC) (http://eur-lex.europa.eu/smartapi/cgi/sga_doc?smartapi!celexapi!prod!CELEXnumdoc&lg=EN&numdoc=32001L0045&model=guichett)

57 According to Article 1 the Annex shall be added to Annex II in Directive 89/655/EEC.

58 Section 4.4

59 Made under Section 15 of the Health and Safety at Work etc. Act. 1974

60 The Work at Height Regulations 2005, SI 2005 No. 735, www.legislation.gov.uk/uksi/2005/735/contents/made

61 "personal fall protection system" means— (a) a fall prevention, work restraint, work positioning, fall arrest or rescue system, other than a system in which the only safeguards are collective safeguards; or (b) rope access and positioning techniques

62 Regulation 8(d)(iii)

Most relevant[63] to the use of a back-up device in industrial rope access:

> **Part 1: Requirements for all personal fall protection systems**
> "A personal fall protection system shall … be so designed, installed and used as to prevent unplanned or uncontrolled movement of the user …"[64].
>
> **Part 3: Additional requirements for rope access and positioning techniques**
> "A rope access or positioning technique shall be used only if … the safety line is equipped with a mobile fall protection system which is connected to and travels with the user of the system …".[65]

6.1.3 Using rope access techniques

The UK Health and Safety Executive (HSE) has published advice on using rope access techniques[66]. A key requirement of rope access equipment is that, "The back-up device should be capable of withstanding any foreseeable forces resulting from the rope access activity, without catastrophic damage to the line or device …".

A dictionary definition[67] of *catastrophic* states the following:

> "Involving or causing sudden great damage or suffering" (adjective)

A definition of *catastrophic failure* is:

> "A catastrophic failure is a sudden and total failure of some system from which recovery is impossible. Catastrophic failures often lead to cascading systems failure …"[68].

6.2 Other relevant legislation

6.2.1 Management of Health and Safety at Work Regulations 1999 (MHSW)[69]

The Management of Health and Safety at Work Regulations 1999 focus on risk assessment and how to use this process effectively to identify potential hazards and risks, as well as the preventive measures that can be applied.

> **Information for employees**
> 10.—(1) Every employer shall provide his employees with comprehensible and relevant information on—
> (a) the risks to their health and safety identified by the assessment;
> (b) the preventive and protective measures; …
>
> **Capabilities and training**
> 13.—(1) Every employer shall, in entrusting tasks to his employees, take into account their capabilities as regards health and safety.
> (2) Every employer shall ensure that his employees are provided with adequate health and safety training—
> (a) on their being recruited into the employer's undertaking; and
> (b) on their being exposed to new or increased risks because of— .

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63 For guidance on the Regulations refer to OC 200/31, The Work at Height Regulations 2005, www.hse.gov.uk/foi/internalops/ocs/200-299/200_31/index.htm
64 Section 2(e)
65 Section 1(d)
66 Safety in window cleaning using rope access techniques, HSE Information Sheet MISC612 (http://www.hse.gov.uk/pubns/misc612.pdf)
67 http://oxforddictionaries.com/definition/english/catastrophic?q=catastrophic
68 http://en.wikipedia.org/wiki/Catastrophic_failure
69 www.legislation.gov.uk/uksi/1999/3242/contents/made

(i) their being transferred or given a change of responsibilities within the employer's undertaking,
(ii) the introduction of new work equipment into or a change respecting work equipment already in use within the employer's undertaking,
(iii) the introduction of new technology into the employer's undertaking, or
(iv) the introduction of a new system of work into or a change respecting a system of work already in use within the employer's undertaking.

(3) The training referred to in paragraph (2) shall—
(a) be repeated periodically where appropriate;
(b) be adapted to take account of any new or changed risks to the health and safety of the employees concerned; and
(c) take place during working hours.

6.2.2 MHSW – ACoP and Guidance[70]

A number of paragraphs are pertinent to rope access training, including refresher training and familiarisation. The latter is particularly relevant where training has been undertaken on one set of equipment, but an employer chooses to use something different.

Approved Code of Practice:

> 80 … Managers should be aware of relevant legislation and should be competent to manage health and safety effectively. Employers should review their employees' capabilities to carry out their work, as necessary. If additional training, including refresher training, is needed, it should be provided.

Guidance:

> "63 … Relevant information on risks and on preventive and protective measures will be limited to what employees need to know to ensure their own health and safety and not to put others at risk. This regulation also requires information to be provided on the emergency arrangements established under regulation 8, …".
>
> ""64 The information provided should be pitched appropriately, given the level of training, knowledge and experience of the employee. It should be provided in a form which takes account of any language difficulties or disabilities. Information can be provided in whatever form is most suitable in the circumstances, as long as it can be understood by everyone. For employees with little or no understanding of English, or who cannot read English, employers may need to make special arrangements. These could include providing translation, using interpreters, or replacing written notices with clearly understood symbols or diagrams …".
>
> "82 The risk assessment and subsequent reviews of the risk assessment will help determine the level of training and competence needed for each type of work. Competence is the ability to do the work required to the necessary standard. All employees, including senior management, should receive relevant training. This may need to include basic skills training, specific on-the-job training and training in health and safety or emergency procedures. There may be a need for further training e.g. about specific risks, required by other legislation …".
>
> "83 Training needs are likely to be greatest for new employees on recruitment. They should receive basic induction training on health and safety, including arrangements for first-aid, fire and evacuation. … The risk assessment should identify further specific training needs. In some cases, training may be required even though an employee already holds formal qualifications (e.g. for an update on new technology) … ".

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70 Management of health and safety at work, Management of Health and Safety at Work Regulations 1999, Approved Code of Practice & guidance, www.hse.gov.uk/pubns/priced/l21.pdf

> "84 An employee's competence will decline if skills are not used regularly (e.g. in emergency procedures, operating a particular item of equipment or carrying out a task). Training therefore needs to be repeated periodically to ensure continued competence …".

6.2.3 Provision and Use of Work Equipment Regulations (PUWER)[71]

The Provision and Use of Work Equipment Regulations 1998 state that:

> "Every employer shall ensure that work equipment is so constructed or adapted as to be suitable for the purpose for which it is used or provided …"[72].

In selecting work equipment:

> "… every employer shall have regard to the working conditions and to the risks to the health and safety of persons which exist in the premises or undertaking in which that work equipment is to be used and any additional risk posed by the use of that work equipment".

Every employer, "… shall ensure that work equipment is used only for operations for which, and under conditions for which, it is suitable". *Suitable* means, "… suitable in any respect which it is reasonably foreseeable will affect the health or safety of any person".

In terms of information:

> "Every employer shall ensure that all persons who use work equipment have available to them adequate health and safety information and, where appropriate, written instructions pertaining to the use of the work equipment …"[73].

In addition:

> "Every employer shall ensure that any of his employees who supervises or manages the use of work equipment has available to him adequate health and safety information and, where appropriate, written instructions pertaining to the use of the work equipment …".

The information and instructions required shall include information and, where appropriate, written instructions on: (a) the conditions in which and the methods by which the work equipment may be used; (b) foreseeable abnormal situations and the action to be taken if such a situation were to occur; and (c) any conclusions to be drawn from experience in using the work equipment.

Information and instructions required shall be readily comprehensible to those concerned.

Every employer shall[74]:

> "… ensure that an item of work equipment has been designed and constructed in compliance with any essential requirements, that is to say requirements relating to its design or construction in any of the instruments listed in Schedule 1[75] (being instruments which give effect to Community directives concerning the safety of products) …".

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71 Provision and Use of Work Equipment Regulations 1998 www.legislation.gov.uk/uksi/1998/2306/contents/made
72 Regulation 4, Suitability of work equipment
73 Regulation 8, Information and instructions
74 Regulation 10, Conformity with Community requirements
75 Schedule 1 Includes the Personal Protective Equipment (EC Directive) Regulations 1992 SI 1992/3139, amended by SI 1993/3074, 1994/2326, 1996/3039

Work equipment should be marked in a clearly visible manner with any marking appropriate for reasons of health and safety[76] and incorporates any warnings or warning devices which are appropriate for reasons of health and safety[77].

6.2.4 PUWER – ACoP and Guidance

Guidance on the Regulations can be found in L22[78] and INDG291[79]. PUWER 98 applies to the provision and use of all work equipment, including mobile and lifting equipment. There is also some overlap between PUWER 98 and other sets of regulations. If you comply with the more specific regulations, it will normally be sufficient to comply with the more general requirements in PUWER 98.

“work equipment” means any machinery, appliance, apparatus, tool or installation for use at work (whether exclusively or not).

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76 Regulation 23, Markings

77 Regulation 24, Warnings

78 Safe use of work equipment, Provision and use of Work Equipment Regulations 1998, Approved Code of Practice and guidance, L22, www.hse.gov.uk/pubns/priced/l22.pdf

79 INDG291, Providing and using work equipment safely, A brief guide, www.hse.gov.uk/pubns/indg291.pdf

7 PART F - EQUIPMENT MANUFACTURERS

This part summarises the implementation of product directives and standards, in particular the 'essential requirements'. Of note, a harmonised standard does not necessarily cover all essential requirements. The prime function of CE marking is to protect against barriers to trade within the European Union. It is not meant to be taken as a mark of quality.

7.1 Preamble

Within Europe, the implementation of directives is mandatory. A distinction should be made between the *supply* and *use* of personal protective equipment; covered in Parts F and G of this review respectively. Within the UK, enforcement is undertaken by different government departments; Business Innovation and Skills (BIS) and the Health and Safety Executive (HSE).

7.1.1 The implementation of Directives[80]

Within the European Union is there is a set of so-called 'New Approach Directives'[81]. These Directives are based on the following principles:

- o Harmonisation is limited to *essential requirements*.
- o Only products fulfilling the essential requirements may be placed on the market and put into service.
- o Harmonised standards[82] are presumed to conform to the corresponding essential requirements.
- o Application of harmonised standards or other technical specifications remains voluntary, and manufacturers are free to choose any technical solution that provides compliance with the essential requirements.
- o Manufacturers may choose between different conformity assessment procedures provided for in the applicable directives.

Furthermore (p25):

> "... the employer must take all measures necessary to ensure that the work equipment (for example machinery and apparatus) made available to the workers is suitable for the work carried out, and may be used by workers without impairment to their safety or health …".

and

> "… the equipment must be appropriate for the risk involved, correspond to existing conditions at the workplace, take into account ergonomic requirements and the worker's state of health, fit the wearer correctly, and be compatible where more than one equipment must be used simultaneously. …".

Guidance on compliance with directives (p27) states:

> "A fundamental principle of the New Approach is to limit legislative harmonisation to the essential requirements that are of public interest. … Essential requirements are

80 A useful source of guidance is *PPE Guidelines*, Guidelines on the application of Council Directive 89/686/EEC of 21 December 1989 on the approximation of the laws of the Member States relating to Personal Protective Equipment (http://ec.europa.eu/enterprise/sectors/mechanical/files/ppe/ppe-guidelines_en.pdf)

81 Guide to the implementation of directives based on the New Approach and the Global Approach, http://ec.europa.eu/enterprise/policies/single-market-goods/files/blue-guide/guidepublic_en.pdf

82 The reference numbers of which have been published in the Official Journal and which have been transposed into *national* standards

> designed to provide and ensure a high level of protection … The essential requirements are set out in annexes to the directives …".

Interestingly (p28):

> "A harmonised standard must match the essential requirements of the relevant directive. A European standard may contain provisions relating not only to essential requirements but also to other provisions. In such a case, these provisions should be clearly distinguished from those covering the essential requirements. Further, a harmonised standard does not necessarily cover all essential requirements. This would oblige the manufacturer to use other relevant technical specifications in order to meet all the essential requirements of the directive. …".

7.2 The Supply of Personal Protective Equipment (PPE)

7.2.1 Directive 89/686/EEC[83]

Equipment used for fall protection that is classified under Directive 89/686/EEC as *personal protective equipment* (PPE) is required to carry CE marking. This applies to most equipment used for personal fall protection.

The prime function of CE marking is to protect against barriers to trade within the European Union. It is not meant to be taken as a mark of quality, although PPE category III is subject to such rigorous controls that this point could be argued otherwise.

Annex II of the Directive contains the 'basic health and safety requirements'. Most relevant to rope access back-up devices are the following, highlighting the need to consider "foreseeable conditions of use":

> "**1. General requirements applicable to all PPE**
> PPE must provide adequate protection against all risks encountered.
>
> **1.1. Design principles**
> *1.1.1. Ergonomics*
> PPE must be so designed and manufactured that in the *foreseeable conditions of use* for which it is intended the user can perform the risk-related activity normally whilst enjoying appropriate protection of the highest possible level.
>
> **1.3. Comfort and efficiency**
> *1.3.2. Lightness and design strength*
> PPE must be as light as possible without prejudicing design strength and efficiency.
> Apart from the specific additional requirements which they must satisfy in order to provide adequate protection against the risks in question (see 3), PPE must be capable of withstanding the effects of ambient phenomena inherent under the foreseeable conditions of use ...".
>
> "**2. Additional requirements common to several classes or types of PPE**
>
> **2.1. PPE incorporating adjustment systems**
> If PPE incorporates adjustment systems, the latter must be so designed and manufactured as not to become incorrectly adjusted without the user's knowledge under the foreseeable conditions of use …".

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83 EUROPEAN COMMUNITIES 89/686/EEC Council Directive on the approximation of the laws of the member states relating to personal protective equipment, and amendments. Luxembourg: Office for the Official Publications of the European Communities, 1989 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31989L0686:EN:NOT

"**3. Additional requirements specific to particular risks** …

3.1.2. Falls

3.1.2.2. Prevention of falls from a height

PPE designed to prevent falls from a height or their effects must incorporate a body harness and an attachment system which can be connected to a reliable anchorage point. It must be designed so that under the foreseeable conditions of use the vertical drop of the user is minimized to prevent collision with obstacles and the braking force does not, however, attain the threshold value at which physical injury or the tearing or rupture of any PPE component which might cause the user to fall can be expected to occur.

It must also ensure that after braking the user is maintained in a correct position in which he may await help if necessary.

The manufacturer's notes must specify in particular all relevant information relating to:

- the characteristics required for the reliable anchorage point and the necessary minimum clearance below the user,
- the proper way of putting on the body harness and of connecting the attachment system to the reliable anchorage point …".

7.2.2 Personal Protective Equipment Regulations 2002[84] [85]

The Personal Protective Equipment Regulations 2002[86] implement Council Directive 89/686/EEC and came into force on 15th May 2002.

Regulation 8 places the duty on any responsible person who places PPE on the market to comply with certain requirements. These requirements are that the PPE must satisfy the *basic health and safety requirements* which are applicable to that class or type of PPE, the appropriate conformity assessment procedures must have been carried out, CE marking must have been correctly affixed and the PPE must not compromise the safety of individuals when properly maintained and used.

The basic health and safety requirements applicable to a particular class or type of PPE are set out in Schedule 2. There is a presumption that the relevant basic health and safety requirements applicable to a class or type of PPE are met if the PPE complies with transposed *harmonised standards* (Regulation 8(2)(a)).

The appropriate conformity assessment procedures applicable to different types of PPE are set out in Regulation 11 by reference to:

- Schedule 3 (which lays down the technical documentation to be supplied by the manufacturer);
- Schedule 7 (which sets out the EC type-examination procedure);
- Schedule 8 (which sets out the checking of PPE manufactured); and
- Schedule 9 (which sets out the EC declaration of production conformity).

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84 http://www.legislation.gov.uk/uksi/2002/1144/contents/made

85 Formerly the Personal Protective Equipment (EC Directive) Regulations 1992, www.legislation.gov.uk/uksi/1992/3139/contents/made

86 The Personal Protective Equipment Regulations 2002 consolidate with amendments the Personal Protective Equipment (EC Directive) Regulations 1992 (SI 1992/3139; as amended by SI 1993/3074, SI 1994/2326 and SI 1996/3039 and extended by section 2(1) of the Economic Area Act 1993, c. 51). The Regulations maintain the implementation of Council Directive 89/686/EEC on the approximation of the laws of the Member States relating to personal protective equipment (OJ No. L399, 30.12.89, p. 18, which was originally implemented by SI 1992/3139)

Regulation 9 requires that any person who supplies PPE must ensure that it is safe. For the purposes of this Regulation, supplying PPE includes putting PPE into service in specified circumstances.

Requirements relating to the CE marking of PPE are set out in Regulation 12 and Schedules 4 and 6.

Regulations 16 to 20 and Schedule 10 provide for the enforcement of the Regulations.

7.3 Product Standards

Within Europe there is a requirement to follow published harmonised standards[87] or, alternatively, submit a 'technical file'. Most relevant to back-up devices are BS EN 353-1, BS EN 12841 and BS EN 358, summarised below:

7.3.1 BS EN 353-2[88]

The Scope of BS EN 353-2 is:

> "This European Standard specifies the requirements, test methods, marking, information supplied by the manufacturer and packaging for guided type fall arresters including a flexible anchor line which can be secured to an upper anchor point. Guided type fall arresters including a flexible anchor line conforming to this European Standard are subsystems constituting a part of one of the fall arrest systems covered by EN 363. Other types of fall arresters are specified in EN 353-1 or EN 360. Energy absorbers are specified in EN 355 …".

The main elements relating to 'materials and construction' are:

> "**4.2 Materials and construction**
> … Flexible anchor wire ropes shall have an attached lower termination or an attachment weight in every case.
> A guided type fall arrester shall be equipped with a connector or a connector-terminated lanyard with a maximum length of 1 m including, if applicable, an energy absorber and connectors. …
>
> **4.4.1 Anchor line**
> When tested as described in 5.2.2.1, textile anchor lines shall sustain a force of at least 22 kN and anchor wire ropes shall sustain a force of at least 15 kN.
>
> **4.4.2 Guided type fall arrester including lanyard and connector**
> When tested as described in 5.2.2.2, the guided type fall arrester including lanyard and connector shall sustain a force of at least 15 kN.
>
> **4.5 Dynamic performance**
> When tested as described in 5.3 with a rigid steel mass of 100 kg, the braking force Fmax shall not exceed 6 kN and the arrest distance H shall be H < 2 L + 1 m with L = Lt for a lanyard including energy absorber, L = Ll for a lanyard without energy absorber and L = length of a connector for a device without lanyard and energy absorber …".

The dynamic performance test is conducted as described in **5.5.2** or **5.8** of EN 364:1992[89]:

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87 http://ec.europa.eu/enterprise/policies/european-standards/harmonised-standards/personal-protective-equipment/

88 BS EN 353-2:2002, Personal protective equipment against falls from a height — Part 2: Guided type fall arresters including a flexible anchor line (For a resume of testing requirements see: www.satrappeguide.com/EN353-2.php)

89 BS EN 364:1993, Personal protective equipment against falls from a height — Test methods

EN 364:1992
5.5.2, Dynamic performance test procedure

In summary:

5.5.2.1 Secure the top of the anchorage line to the rigid structural anchorage point incorporating the force measuring instrument …
5.5.2.2 Hold the fall arrester as in the normal condition of use within 300 mm of the top of the anchorage line. Attach the fall attester to the 100 kg mass by means of its lanyard and connectors.
5.5.2.3 Raise the mass as far above the arrester as the lanyard and connectors permit, and at a maximum of 300 mm horizontally from the structural anchorage. Hold the mass by the quick release device.
5.5.2.4 Let the mass fall and measure the peak force during the arrest stage. After the fall and with the mass at rest, measure the displacement H of the point of attachment of the mass.
5.5.2.5 If the arrester is designed to be attached directly to a harness the system shall be tested in accordance with 5.8.

EN 364:1992
5.8, Dynamic test for systems with a harness connected direct to a guided type fall arrester on flexible anchorage rope

The purpose of this test is to ensure that when guided type fall arresters are directly connected to a harness the system is operationally compatible.

In summary:

5.8.2.1 Fit the torso dummy with the harness and attach the harness to the fall arrester by means of the direct connector supplied.
5.8.2.2 Secure the top of the anchorage line to the rigid structural anchorage point incorporating the force measuring instrument …
5.8.2.3 Suspend the torso dummy by its upper attachment point and raise this until the arrester is within 300 mm of the top of the anchorage line and the torso dummy no greater than 300 mm horizontally from the structural anchorage. Hold the torso dummy by the quick release device.
5.8.2.4 Let the torso dummy fall and measure the peak force during the arrest stage. After the fall and with the torso dummy at rest, measure the displacement H of the point of attachment of the torso dummy.
NOTE The strength tests for a guided type fall arrester with a flexible anchorage rope are described at 5.5.4 and 5.5.6.

7.3.2 BS EN 12841 (Type A)[90]

Type A rope adjustment devices, Requirements

The main requirements in BS EN 12841: 2006 can be summarised as follows:

- Test to the minimum and maximum diameter as marked on the rope adjustment device (4.1.1)
- Device shall be compatible with and capable of attachment to an anchor line of the type and diameter range as marked on the rope adjustment device (4.1.2)
- Devices shall have a maximum rated load of at least 100 kg for a single person rope adjustment device and at least 200 kg for a two-person rope adjustment device (4.1.8)
- Functional requirements after conditioning to wet (4.1.9)

[90] BS EN 12841:2006, Personal fall protection equipment - Rope access systems – Rope adjustment devices

- o Devices shall have a maximum braking force Fmax of 6 kN and an arrest distance Ha of maximum 2 m when tested with a rigid steel mass of 100 kg or a mass equivalent to the maximum rated load, whichever is the greater (4.2.5 Dynamic performance)
- o Devices shall not release the mass when tested with a rigid steel mass of 100 kg or a mass equivalent to the maximum rated load, whichever is the greater, and the arrest distance shall be a maximum of 2 m (4.2.6 Dynamic strength)
- o Devices shall have a minimum residual strength of 3 kN for 3 min (4.2.7 Residual strength)

Dynamic performance

The main dynamic performance testing can be summarised as follows:

- o If the device is to be tested on two anchor lines, first carry out with the test with the *minimum* diameter anchor line, and then repeat the test with the other anchor line (5.6.2.1)
- o Position the device 1m below the force measurement instrument (5.6.2.2)
- o Attach the device to the rigid steel mass and suspend the mass for 60 s (5.6.2.3)
- o Raise the mass by twice the length of the connecting element, at a horizontal distance of 250 mm from the anchor point. Hold the mass by a quick release device (5.6.2.4, .5 and .6)
- o Let the mass fall and measure the peak force (Fmax) during the arrest stage. With the mass at rest, measure the arrest distance (H_a) (5.6.2.7)

7.3.3 BS EN 358[91]

Dynamic performance
Work positioning and sit harnesses are subjected to a drop test to generate a shock load on the harness. Commensurate with its end use, a lesser force is applied to the harness as the possibility of a period of free-fall is significantly less in use. Work positioning attachments are subjected to a 1 m drop with a 1 m length of rope, whereas sit harnesses are dropped over a distance of 2 m with a 1 m length of rope. In both cases, the harness is required only to safely arrest the fall of the test dummy following the drop.

Static strength
Belts, harnesses and lanyards are subject to a 15 kN tensile force. Tensile forces are applied and held for at least 3 min.

Corrosion resistance
Metallic components are subjected to a neutral salt-spray test intended to prove a minimum resistance to environmental corrosion, e.g. rust. Products are held within a sealed chamber, which is filled with a salt-water mist, which can induce rust in unprotected metals. Products are subjected to either 24 or 48 hours exposure and examined for rusting and function afterward.

7.3.4 Reproducibility etc.

In the context of testing with dummies, an AGARD (Advisory Group for Aerospace Research and Development)[92] Advisory Report raises some interesting issues about the choice of test surrogate. Some of these criteria are equally applicable to the testing of *any* rope access equipment (whether with test dummies or not):

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91 BS EN 358: 2000, Personal protective equipment for work positioning and prevention of falls from a height - Belts for work positioning and restraint and work positioning lanyards (For a resume of testing requirements see: www.satrappeguide.com/EN358.php)

92 AGARD (Advisory Group for Aerospace Research and Development), Advisory Report 330, Anthropometric dummies for crash and escape testing

Anthropometry
The dummy should have similar shape, mass distribution and joint articulation to that of the human.

Biofidelity
The dummy should duplicate the biomechanical response behaviour of a living human exposed to the same impact conditions. A high level of biofidelity is required to assess injury risk.

Measurement capability
The dummy should be instrumented to provide measurements of appropriate forces, moments, deflections and accelerations.

Repeatability
The dummy should give the same response (output) to the same impact (input) conditions for repeated tests. Repeatability is assessed from peak responses to repeated tests with the same dummy. A coefficient of variation of 10% is generally considered as an acceptable measure of repeatability, though figures of 3% can be obtained.

Reproducibility
Different dummies of the same design should give identical responses to similar impact.

Durability
Durability implies that the dummy should remain structurally sound following an impact and, moreover, its responses should remain biofidelic and repeatable.

Sensitivity
The dummy should not be sensitive to extraneous conditions such as temperature and humidity effects that would affect its biofidelity and repeatability.

Simplicity and ease of use
The dummy should be easy to calibrate, require minimal external support equipment and be readily repairable. Dummy parts should be easy to change and replace.

8 PART G - USERS OF EQUIPMENT

This part summarises the requirements for those selecting and using fall protection equipment. The guidance and standards would be cited as informing any expert opinion on what is reasonably foreseeable misuse.

8.1 The Use of Personal Protective Equipment (PPE)

The reader is reminded that a distinction should be made between the *supply* and *use* of personal protective equipment; covered in Parts F and G of this review respectively. Equipment must be effective in preventing or adequately controlling the risk or risks involved.

8.1.1 Directive 89/656/EEC[93]

Directive 89/656/EEC lays down minimum requirements for personal protective equipment used by workers at work. Personal protective equipment shall be used when the risks cannot be avoided or sufficiently limited by technical means of collective protection or by measures, methods or procedures of work organization[94].

Annex II gives a non-exhaustive guide list of items of personal protective equipment. This includes equipment designed to prevent falls:

- o Fall-prevention equipment (full equipment with all necessary accessories).
- o Braking equipment to absorb kinetic energy (full equipment with all necessary accessories).
- o Body-holding devices (safety harness).

In the UK, the Directive is implemented through the Personal Protective Equipment at Work Regulations 1992[95].

8.1.2 The Personal Protective Equipment (PPE) at Work Regulations 1992

The Personal Protective Equipment at Work Regulations 1992 (PPEWR) require that:

> "… personal protective equipment shall not be suitable unless … so far as is practicable, it is effective to prevent or adequately control the risk or risks involved without increasing overall risk …"[96].

Before choosing any personal protective equipment:

> "… an employer or self-employed person shall ensure that an assessment is made to determine whether the personal protective equipment he intends will be provided is suitable …" [Assessment of personal protective equipment][97].

An employer shall:

> "… also ensure that the employee is provided with such information, instruction and training as is adequate and appropriate to enable the employee to know—(a) the risk or risks which the personal protective equipment will avoid or limit; (b) the purpose for

93 COUNCIL DIRECTIVE of 30 November 1989 on the minimum health and safety requirements for the use by workers of personal protective equipment at the workplace (third individual directive within the meaning of Article 16 (1) of Directive 89/391/EEC) (89/656/EEC) (OJ L393, 30.12.1989, p.18) http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31989L0656:EN:HTML

94 Article 3, General rule

95 SI 1992 No. 2966, www.legislation.gov.uk/uksi/1992/2966/made

96 Regulation 4(3)(d)

97 Regulation 6(1)

which and the manner in which personal protective equipment is to be used; …" [Information, instruction and training][98].

Every employer shall:

"… take all reasonable steps to ensure that any personal protective equipment provided … is properly used …" and "… shall use any personal protective equipment provided to him … in accordance both with any training … and the instructions respecting that use which have been provided to him …" [Use of personal protective equipment][99].

8.1.3 PPE - Guidance

The HSE Guidance[100] - stating that the Personal Protective Equipment at Work Regulations came into force on 1st January 1993 and have subsequently been amended[101] - provides guidance to employers to help them comply with their duties to select suitable PPE, use and maintain it. It describes the PPE used for different parts of the body and includes PPE used to prevent falls from height.

One of the common selection, use and maintenance points for PPE is to:

"… ensure that items of PPE used together are compatible with each other to ensure they continue to be effective against the risks"[102].

Key points to note about personal fall protection[103] are:

(a) Consider all elements when selecting suitable equipment – the maximum descent height and load; safe and secure anchorage points; the length, type and number of ropes and lanyards; the specification of ascender/descender devices; a system for recovery after a fall. Regulation 5 of the Lifting Operations and Lifting Equipment Regulations 1998 (LOLER) requires that equipment used for lifting or lowering people is safe.

(b) Inspect equipment at regular intervals. Regulation 9 of LOLER requires lifting equipment for lifting people to be examined every six months by a competent person if it is exposed to conditions causing deterioration which is liable to result in dangerous situations.

(c) Special care needs to be taken when inspecting components made from webbing and rope because of the deterioration that can take place in these materials. Guidance on this topic and the recommended inspection frequency can be found in INDG367[104].

Further guidance[105] states that PPE is, "… equipment that will protect the user against health or safety risks at work …" and, "It can include items such as … safety harnesses" and

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98 Regulation 9(1)(a) and (b)

99 Regulation 10(1) and (2)

100 Personal Protective Equipment at Work (Second edition). Personal Protective Equipment at Work Regulations 1992 (as amended). Guidance on Regulations L25 (Second edition), HSE Books, 2005, ISBN 978 0 7176 6139 8, www.hse.gov.uk/pubns/priced/l25.pdf

101 by the Police (Health and Safety) Regulations 1999 (SI 1999/860), the Health and Safety (Miscellaneous Amendments) Regulations 2002 (SI 2002/2174) and the Ionising Radiations Regulations 1999 (SI 1999/3232)

102 Paragraph 73(c)

103 Paragraph 100

104 INDG367, Inspecting fall arrest equipment made from webbing or rope www.hse.gov.uk/pubns/indg367.pdf

105 Personal protective equipment (PPE) at work: A brief guide, INDG174 www.hse.gov.uk/pubns/indg174.pdf

regulation requires that, "… any PPE you buy is 'CE' marked and complies with the requirements of the Personal Protective Equipment Regulations 2002. The CE marking signifies that the PPE satisfies certain basic safety requirements and in some cases will have been tested and certified by an independent body …".

8.2 Codes of Practice (British Standards Institution)

Relevant to industrial rope access, the following British Standards are available[106]:

8.2.1 BS 7985: 2009[107]

The British Standard, BS 7985: 2009[108] gives the following advice about the selection of back-up devices[109]:

"5.2.8 The back-up device (on the safety line) should be capable of withstanding any foreseeable forces resulting from the rope access activity, without catastrophic damage to the safety line or the device. See 8.3.10.
NOTE These forces can be minimized by keeping the back-up device high to prevent or limit a fall. …".

"8.3.10 Back-up devices
8.3.10.1 Back-up devices are used to attach the operative to the safety line. Back-up devices should be used which are capable of withstanding any foreseeable forces resulting from the rope access activity that could be placed on them, without catastrophic damage to the safety line or to the device itself. They should be chosen bearing in mind their suitability for use in the prevailing environmental conditions, for example wet, muddy, icy, abrasive or corrosive conditions.

8.3.10.2 In the event of a failure of the working line or loss of control by the operative, back-up devices are intended to lock on to the safety line without causing catastrophic damage to the line and also to absorb the limited shock load that might occur. Back-up devices should always be positioned on the safety line so that, in the event of a failure in the working line system, the load will be taken on the back-up device in such a way that a fall is prevented or minimized. There is an advantage in using back-up devices that can be released by the operative without de-weighting first. However, correct functioning of this type of back-up device critically relies on the loading being applied via the cam and not the body (i.e. grabbing the body of the device could cause it to slide down the rope and prevent it from functioning properly). Devices requiring minimal operator manipulation should be used.

NOTE An appropriate standard for back-up devices is BS EN 12841. Some types of fall arrest device which conform to BS EN 353-2 might also be appropriate, provided that they can be positioned on the safety line by the user. …".

Also:

"8.3.1.3 The behaviour under load of components in the system, such as dynamic cow's tails, load-limiting back-up devices and the extension of the low-stretch rope, can help to absorb any forces generated, should there be a limited fall. However, the system generally should be designed to avoid this, i.e. it should

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106 See http://shop.bsigroup.com/
107 Work in progress
108 BS 7985:2009, Code of practice for the use of rope access methods for industrial purposes
109 back-up device: rope adjustment device for a safety line of appropriate type and diameter, which accompanies the user during changes of position or allows adjustment of the length of the safety line, and which locks automatically to the safety line, or only allows gradual movement along it, when a sudden load is applied [3.2.5.3]

be a work positioning system. … When choosing equipment for a particular application, account should be taken of weakening factors, such as the loss of strength at knots.

8.3.1.4 Any equipment chosen to support a person at a height should be such that it cannot be accidentally removed, dislodged or become unfastened from the rope while a person is suspended from it. This applies particularly to connectors, rope adjustment devices and harnesses. …".

8.2.2 BS ISO 22846-1

The British Standard, BS ISO 22846-1: 2003[110] gives the following advice about the selection of back-up devices[111]:

"3.10 The back-up device (on the safety line) should be capable of withstanding any foreseeable forces resulting from the rope access activity, without catastrophic damage to the safety line or the device.

NOTE These forces can be minimized by keeping the backup device high to prevent or limit a fall. …".

8.2.3 BS ISO 22846-2

The British Standard, BS ISO 22846-1: 2012[112] gives the following advice about the selection of back-up devices[113]:

"6.4.7 Back-up devices

The selection criteria for back-up devices include:

a) energy-absorbing capabilities, e.g. a maximum impact force of 6 kN;
b) ability to self-manage (e.g. needing little or no user intervention);
c) ability to arrest a fall gradually rather than suddenly;
d) ability to keep falls as short as possible;
e) compatibility with rope type and diameter;
f) ability to not cause catastrophic damage to safety line or device under foreseeable forces;
g) ability to not inadvertently disconnect from the rope;
h) suitability for work environment, e.g. ice on the rope;
i) suitability for body weight and work method being undertaken;
j) ease of unloading post-fall;
NOTE Ease of unloading post-fall can be an important feature during a workmate rescue/retrieval.

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110 Personal equipment for protection against falls — Rope access systems, Part 1: Fundamental principles for a system of work

111 back-up device: rope adjustment device for a safety line of appropriate type and diameter, which accompanies the user during changes of position or allows adjustment of the length of the safety line, and which locks automatically to the safety line, or only allows gradual movement along it, when a sudden load is applied in one direction, e.g., in the event of a fall [2.4]

112 Personal equipment for protection against falls — Rope access systems, Part 2: Code of practice

113 back-up device: rope adjustment device for a safety line of appropriate type and diameter, which accompanies the user during changes of position or allows adjustment of the length of the safety line, and which locks automatically to the safety line or only allows gradual movement along it, whenever a sudden load is applied in one direction [2.7]

NOTE 1 The event of a fall is an example of when a sudden load is likely to be applied in one direction.
NOTE 2 Some back-up devices have the additional capacity to control energy in the event of a fall.

k) ability to position the device on the rope (i.e. in some work situations, the operative needs to be able to position the back-up device at a particular location on the rope);

l) being designed so that any failure of the device results in the activation of a safe mode. …".

8.2.4 BS 8437: 2009

Within BS 8437: 2009, recommendations and guidance on the use of rope access methods are given in BS 7985.

9 PART H - GUIDANCE (UK)

This part summarises the main guidance documents available to those planning industrial rope access work. These have developed over many years and may be considered to illustrate good and/or best practice. They may cited as supporting expert opinion on what is reasonably foreseeable misuse.

9.1 Industry Guidance

IRATA International has been proactive, from its early days, in setting out the technical and training requirements for industrial rope access.

9.1.1 General requirements for certification of personnel engaged in industrial rope access methods

IRATA produced the first edition of ‘General requirements for certification of personnel engaged in industrial rope access methods’ (the IRATA *General requirements*) in 1992, as a scheme of training and qualifications focusing on safety[114].

9.1.2 IRATA International code of practice (ICOP)[115]

The IRATA International code of practice[116] gives the following advice about the selection of back-up devices:

2.7.7.3 When used in accordance with the manufacturer’s instructions, the combination of back-up device, device lanyard, connectors and harness should be able to limit the force on the user to a maximum of 6.0 kN in the event of a working line failure.

NOTE 6 kN is a recognized threshold of injury.

2.7.7.5 When selecting a back-up device, it is essential that the probability of foreseeable misuse and the consequences of such misuse are assessed. When such an assessment has been made, a residual risk of misuse may exist, which should be addressed by identifying and applying specific control measures, such as the selection of alternative equipment, extra training, modification of work practices, increased supervision or a combination of these.

2.7.7.6 Special consideration should be given to the suitability and performance of back-up devices if they might be used during rescue, because potential loads could be significantly higher than the manufacturer’s maximum rated load.

2.7.7.7 Additional selection criteria for a back-up device include:

a) that the anticipated loading is appropriate for the mass of the rope access technician including any equipment worn, i.e. in accordance with the manufacturer’s maximum rated load;
b) the suitability with regard to arresting the mass of the user, including any equipment worn or carried;
c) the ability to keep any fall as short as possible;
d) that it does not cause catastrophic damage to the safety line when arresting a fall;

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114 A companion publication is ‘IRATA Guidelines on the use of rope access methods for industrial purposes’ has been used to establish safe national standards for rope access (UK).

115 Following the ICOP is *mandatory* for IRATA Members.

116 IRATA International code of practice for industrial rope access (2013 edition), Part 2: Detailed guidance

e) the suitability with regard to arresting a two-person load if workmate retrieval is going to be carried out;
f) that it cannot be inadvertently disconnected from the safety line;
g) compatibility with the safety line type and diameter;
h) the ability to position the device anywhere on the safety line;
i) the suitability for the prevailing environmental conditions, e.g. wet; icy; dirty; abrasive; corrosive;
j) minimal manipulation required by the rope access technician;
k) preferably fail to safe in all modes of operation, e.g. prevent or arrest a fall even when gripped in panic.

9.2 Company Guidance

Some companies have set out their own guidance for rope access operations.

9.2.1 Shell[117]

In a Shell guide for non-rope access engineers and supervisors it is stated:

> The rope access service provider shall have their own rope access operating procedures & work instructions. Those procedures, together with the International Standard BS EN ISO 22846-2 *Personal equipment for protection against falls – Rope access systems- Part: 2 Code of Practice*, should be readily available to its operatives.

It is noted:

> To ensure a rope access system operates correctly, the following factors are essential:
> - o System management and planning;
> - o Competence of the operatives and correct team composition;
> - o Equipment selection, use and maintenance;
> - o Properly organized and executed working methods.
>
> A failure or shortcoming in any of the above could render the entire system deficient.

9.3 Other Standards and Codes of Practice

See Annex 4.

117 Rope access operations: A Guide for 'non-rope access' engineers and supervisors; February 2013

10 PART I - GUIDANCE (NON-UK)

This part looks at other rope access guidance. It is hoped that any future update of this review will include further information.

10.1.1 FISAT: Examination guidelines for rope access, Version 12.0[118]

The FISAT *Examination guidelines for rope access* (2012), state:

"**1. General**

1.1 Conformity with standards

1.1.1 Rope Access with kernmantel rope technology may be conducted in accordance with FISAT's Safety and Work Guidelines. Other procedures may be followed if codified in the guidelines of other countries' guidelines and in accordance with recognized technical standards.

1.1.2 Rope Access may only be conducted by properly trained and certified users. …".

"**1.3 Requirements for equipment used**

1.3.1 Equipment used for Rope Access must be in conformity with valid standards, bear the CE symbol, and exclude endangerment of the user. …".

10.1.2 SPRAT: Safe practices for rope access work[119]

The SPRAT *Safe practices for rope access work* (2007), state:

"Rope Grab:
A device used to grasp a life safety rope for the purpose of supporting a load.

10.6 *Rope Grabs
Rope grabs should be of a type that will not slip at a static load below 2.25 kN (550 lbs). Rope grabs should be of a type that cannot be accidentally detached from the rope. Ascenders should be chosen so as to minimize the risk of damage to the rope when in use.

A10.6 Rope grabs may be used to ascend a rope or to attach the operator to a safety line. In the event of a failure of the main line or loss of control by the operator, rope grabs are intended to grip the safety rope without causing damage to the rope and also help absorb any shock load which may occur. …".

10.1.3 ARAA Technical Recommendation – Back-up devices[120]

An ARAA *Technical Guidance Note* gives the following recommendation:

"**Specifics**
Fall arrest or 'back up' devices used during rope access works shall be connected either to the sternal … or in limited cases dorsal … attachment points of the operator's harness. Whilst it has been extremely common in the past (& still is at present) for fall arrest type devices to be attached to the end of a ventrally … anchored lanyard this method is largely untenable. Certainly no form of fall arrest device may ever be used attached to a single lateral … attachment point.

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118 www.fisat.de/fileadmin/servicedokumente/fisatregelwerke_01/Pruefungsordnung_PO-SZP_Version_12.0_eng.pdf

119 www.rescueresponse.com/store/media/pdf/SPRAT_Safe_Practices_for_Rope_Access_Work_English.pdf

120 Technical Guidance Note 14.11.12, http://araa.net.au/directory_downloads/Tech%20Note%20-%20Back%20Up%20Connection%20Points.pdf

Research, testing and anecdotal evidence stretching back more than a decade has demonstrated that ventral connection in a fall arrest situation, and subsequent post fall suspension, has significant limitations. Fall arrest forces may in certain circumstances be greater than an adult human body can withstand without injury if applied to the lower spine/pelvic region. To compound this issue, post fall suspension of a semi or unconscious person ventrally would place the individual in an extreme position of hyperextension (waist high, head and feet low). This position may lead to a host of issues, not the least of which being a compromised airway.

Dorsal attachment is always an option in certain circumstances but needs to [be] weighted against the inherent risks. Post fall dorsal suspension places an operator at great risk of Harness Hang Syndrome (Compression Avascularisation Re-Perfusion Syndrome) & could make self-rescue very difficult if not impossible.

Sternal attachment of one or more fall arrest devices will potentially give the highest margin of security & place the operator in the most appropriate post fall suspension position.

Equipment
All fall arrest type devices used for rope access works need to be used in accordance with the manufacturer's instructions. If in doubt technicians should consult the information included with the product or on the manufacturer's website. …".

11 ANNEXES

Supplementary information is included in number of Annexes:

- o Annex 1 - Legal
- o Annex 2 - Legal Judgements
- o Annex 3 - Other Rope Access Associations
- o Annex 4 - Other Standards and Codes of Practice
- o Annex 5 - Testing Videos

11.1 ANNEX 1 - Legal

Annex 1 provides some detail to the background of the Health and Safety at Work etc. Act 1974.

11.1.1 Health and Safety at Work etc. Act 1974: Background[121]

The Health and Safety at Work etc. Act 1974 was an important development in industrial safety legislation. It introduced a new approach to health and safety with emphasis on self-regulation and employee participation. It applies to all workplaces, whatever the type of business. Employers, the self-employed and everyone at work or anyone who is affected by work activities, are affected by the Act.

Prior to the 1974 Act, the approach to industrial safety was based on legislation that had grown in a piecemeal fashion over the last 100 years. Acts of Parliament were passed and extended to deal with particular hazards and work activities as they arose. Despite the vast amount of legislation, millions of workers were not covered by law in the course of their employment and there was no statutory provision for the protection of the public.

This could not continue so, in 1970 the Government set up a committee (chaired by Lord Robens) to review the situation[122]. It considered what changes were needed in the scope and nature of the major Acts and Regulations. The 'Robens Report' was published in June 1972.

The fundamental conclusion was:

> "There are severe practical limits on the extent to which progressively better standards of safety and health at work can be brought about through negative regulation by external agencies. We need a more effectively self-regulating system. This calls for the acceptance and exercise of appropriate responsibility at all levels within industry and commerce. It calls for better systems of safety organisation, for more management initiative and for more involvement of work people themselves ….".

From this report by Lord Robens the Health and Safety at Work etc. Act 1974 came into being.

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121 www.legislation.gov.uk/ukpga/1974/37/contents
122 www.hse.gov.uk/aboutus/reports/30years.pdf

11.2 ANNEX 2 - Legal Judgements

Annex 2 provides detailed extracts from two Court judgements relating to risk and what is considered safe.

11.2.1 Tangerine Confectionary Ltd and Veolia ES (UK) Ltd[123]

A Judgement in the Court of Appeal (Criminal Division) includes opinion about the term 'risk':

Para. 24:

> "… when the legislation refers to risk it is not contemplating risks that are trivial or fanciful. It is not its purpose to impose burdens on employers that are wholly unreasonable. Its aim is to spell out the basic duty of the employer to create a safe working environment …
>
> The law does not aim to create an environment that is entirely risk free. It concerns itself with risks that are material. That, in effect, is what the word 'risk' in the statute means. It is directed at situations where there is a material risk to health and safety, which any reasonable person would appreciate and take steps to guard against".

Para.33:

> "The Supreme Court held, by majority, that foreseeability does play a part in assessing risk, or lack of safety. There was, it held, no absolute and unchanging concept of lack of safety. …".
>
> "… what is 'safe' is an objective question in the sense that safety must be judged by reference to what might reasonably be foreseen by a reasonable and prudent employer ... Opinions as to what is safe may vary over time as, with developing knowledge, changes occur to the standards that are reasonably expected to be followed. I do not, therefore, agree with Smith LJ … that what is objectively safe cannot change with time. Standards of safety are influenced by the opinion of the reasonable person and foreseeability of risk plays a part in the forming of that opinion. …".
>
> "… the foreseeability of a risk is distinct from the question whether it was 'reasonably practicable' to avoid it. …".

Para. 36:

> "Foreseeability of risk (strictly foreseeability of danger) is indeed relevant to the question whether a risk to safety exists. That accords with the ordinary meaning of risk, as is demonstrated by the concept of a risk assessment, which is itself an exercise in foresight. Whether a material risk exists or does not is, in these cases, a jury question and the foreseeability (or lack of it) of some danger or injury is a part of the enquiry. None of this, however, means that in a prosecution under either section[124] it is incumbent on the Crown to prove that the accident which occurred was foreseeable. That would convert the sections into ones creating offences of failing to take reasonable care to avoid a specific incident. It means no more than that the sections are concerned with exposure to risk of injury, and that the extent to which injury is foreseeable is part of the enquiry into the level of risk. The sections do not command an enquiry into the likelihood (or foreseeability) of the events which have in fact occurred. They command an enquiry into the possibility of injury. They are not limited, in the risks to which they apply, to risks which are obvious. They impose, in effect, a duty on employers to think deliberately about things which are not obvious. …".

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123 [2011] EWCA Crim 2015, 19 August 2011, http://www.crownofficechambers.com/assets/docs/news/tangerine_judgment.pdf

124 HSWA Sections 2 and 3

11.2.2 Baker v Quantum Clothing Group[125]

A Judgement in the Supreme Court includes opinion about what is ‘safe’:

Para. 71

"‘Safe’ is the converse of ‘dangerous’. A working place is ‘safe’ if there is nothing there which might be a reasonably foreseeable cause of injury to anyone working there, acting in a way in which a human being may reasonably be expected to act, in circumstances which may reasonably be expected to occur …".

Para. 72

"… "The obligation is to anticipate situations which may give rise to accidents" …".

Para. 81

"… The Court of Appeal … said … :
"Under the statute, the employer must first consider whether the employee's place of work is safe. If the place of work is not safe (even though the danger is not of grave injury or the risk very likely to occur) the employer's duty is to do what is reasonably practicable to eliminate it. Thus, once any risk has been identified, the approach must be to ask whether it is practicable to eliminate it and then, if it is, to consider whether, in the light of the quantum of the risk and the cost and difficulty of the steps to be taken to eliminate it, the employer can show that the cost and difficulty of the steps substantially outweigh the quantum of risk involved. I cannot see how or where the concept of an acceptable risk comes into the equation or balancing exercise. I cannot see why the fact that a responsible or official body has suggested that a particular level of risk is 'acceptable' should be relevant to what is reasonably practicable. In that respect, it appears to me that there is a significant difference between common law liability where a risk might reasonably be regarded as acceptable and statutory liability where the duty is to avoid any risk within the limits of reasonable practicability." …".

Para. 82

"In the light of my conclusion that safety is a relative concept, the correctness of these passages does not strictly arise for consideration in this case. Had it arisen, I would have regarded the qualification as wide enough to allow current general knowledge and standards to be taken into account. Even the Court of Appeal in its formulation acknowledged the quantum of risk involved as material in the balancing exercise. But this can only mean that some degree of risk may be acceptable, and what degree can only depend on current standards. The criteria relevant to reasonable practicability must on any view very largely reflect the criteria relevant to satisfaction of the common law duty to take care. Both require consideration of the nature, gravity and imminence of the risk and its consequences, as well as of the nature and proportionality of the steps by which it might be addressed, and a balancing of the one against the other. Respectable general practice is no more than a factor, having more or less weight according to the circumstances, which may, on any view at common law, guide the court when performing this balancing exercise …".

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[125] Hilary Term [2011] UKSC 17, On appeal from: [2009] EWCA Civ 499, http://www.supremecourt.gov.uk/decided-cases/docs/UKSC_2009_0108_Judgment.pdf

11.3 ANNEX 3 - Other Rope Access Associations

Annex 3 provides link to several rope access Associations worldwide. Where known, links have been provided to any guidance that they have produced.

11.3.1 Australia (ARAA)

http://www.araa.net.au/

The Australian Rope Access Association (formally the Industrial Rope Access Association) was formed in 1997 by a group of independent access workers to meet and further the interests of Australian industrial access companies/workers.

> See:
> *Industrial rope access method*
> http://araa.net.au/directory_downloads/COP_2005_sept_ver2.pdf
> *Industrial rope access checklist*
> www.worksafe.vic.gov.au/__data/assets/pdf_file/0017/13076/industrial_rope_access_checklist.pdf

11.3.2 Denmark/Sweden (BARA)

www.bara.dk/

Brancheforeningen for **A**utoriseret **R**ope **A**ccess, BARA's purpose is to create, develop and expand contacts among people and companies who work with authorized (certified, examined) rope access based on published standards (pass criteria, certification requirements).

> See:
> *Vagednin/handledning for rope access arbete (industriklattring)*
> www.bara.dk/vejl/RAvejlSV.pdf
> *Vejledning for rope access arbejde*
> www.bara.dk/vejl/RAvejl.pdf

11.3.3 France (DPMC)

www.dpmc.eu/

The non-profit organisation "**D**éveloppement et **P**romotion des **M**étiers sur **C**ordes" (DPMC, Development and Promotion of the Rope Technician) was created in 2002 by social partners of the French climbers network. Its role is to promote the interests of the profession, define and update the technical regulations for the Rope Technicians, the companies that employ them and training centres.

11.3.4 Germany (FISAT)

www.fisat.de/

FISAT is a professional association for all who are concerned with the commercial use of ropes for work and rescue, offering comprehensive information on professional rope access and positioning techniques from training to testing.

> See:
> *Examination guidelines for rope access, Version 12.0*
> www.fisat.de/fileadmin/servicedokumente/fisatregelwerke_01/Pruefungsordnung_PO-SZP_Version_12.0_eng.pdf

11.3.5 India
http://www.iraassoc.in/news/

The Indian Rope Access Network was set up to serve the industry in India by providing training and information related to industrial rope access that will lead to extreme safety and excellence in this arena. It wants to: see the new BS ISO 22846-2:2012 applied that will lead to a safe working environment at heights; Co-ordinate with governmental bodies, equipment manufacturers and industry leaders; Promote rope access methods to the 'working at heights'- industry; Improve skill and professionalism among our affiliates and the rope access industry in general.

11.3.6 New Zealand (IRAANZ)
http://iraanz.co.nz/

The Industrial Rope Access Association of New Zealand regulates and develops the rope access industry in New Zealand. It has a wide membership and is recognised by Occupational Safety and Health as the representative body for the industry.

> See:
> *Industrial Rope Access in New Zealand: Best Practice Guidelines (May 2012)*
> http://www.osh.govt.nz/order/catalogue/pdf/industrial-rope-access-guidelines.pdf

11.3.7 Norway (SOFT)
www.softsertifisering.no/ (www.ttsoft.no/)

Founded in Stavanger 20 January 2000, *Samarbeidsorganet for tilkomstteknikk* (SOFT) is a trade association for providers and users of rope work (rope). It is a neutral and independent membership organisation whose purpose is to promote safety and quality of execution of rope and particularly work at height in general.

11.3.8 South Africa (IFWH)
www.ifwh.co.za/

Formed in January 2009, the Institute for Work at Height is a merger of the Specialised Access Engineering Manufacturers Association (SAEMA) and the Rope Access And Fall Arrest Association (RAFAA) desirous of creating safety awareness and in turn "professionalism in the overall Work At Height Industry".

11.3.9 Spain (ANETVA)
http://anetva.org/portada/en/index.html

ANETVA is a business association with a national scope that represents the interests of a wide range of companies engaged in rope access work. The main objective of the Association is to represent and defend the interests of its members and of rope access work activities, as well as promoting and providing information on this activity as a safe, quick and efficient way to carry out work at height.

11.3.10 UK/International (IRATA)
www.irata.org/

IRATA was formed in the UK in the late 1980s to solve maintenance problems in the offshore oil and gas industry. Its formation was the result of an initiative of a number of leading companies who had begun to use industrial rope access techniques, to provide a safe working environment for the industry. The rope access technique developed has now come to be used in a wide range of repair, maintenance, inspection and access work.

11.3.11 USA (SPRAT)
http://sprat.org/

The Society of Professional Rope Access Technicians (SPRAT) is a member-driven organization that advances the safe use of rope access through education, developing standards, and administering certifications. It supports companies and technicians using rope access with regulatory support, networking, and opportunities to participate in developing industry-consensus standards.

See:
Safe practices for rope access work
http://www.sprat.org/resources/Safe_Practices - August 2012.pdf
Certification requirements for rope access work
http://www.sprat.org/resources/Certification_ Requirements_November_12.pdf

11.4 ANNEX 4 - Other Standards and Codes of Practice

Annex 4 provides relevant extracts from non-UK standards and codes of practice.

11.4.1 ASTM E2505 - 07 Standard Practice for Industrial Rope Access

ASTM E2505 – 07[126] provides guidance on the use of rope access as an alternative to other methods of access. It provides a framework of practical and technical information within which the specifying authority and the operators using rope access techniques can develop effective arrangements to help ensure the safety and health of personnel involved in these projects.

11.4.2 Industrial Rope Access in New Zealand: Best Practice Guidelines (May 2012)[127]

The New Zealand Ministry of Business Innovation and Employment states:

"**5.2 Standards**
EN certification (European Committee for Standardization) is used extensively in these guidelines. EN certification is recognised as the most modern and coherent set of applicable and compatible rope access equipment standards. …

AS/NZS 4488:1+2:1997 Industrial rope access systems have not been updated since its publication. European standards relating to rope grabs, back-ups and descenders now exist, as well as methodology allowing for lead and aid climbing situations that were not previously described in AS/NZS 4488.

Other internationally-accepted standards such as NFPA (National Fire Protection Association) and ANSI (American National Standards Institute) should be referenced with care to ensure that all elements within a rope access system are compatible. …".

11.4.3 Australian/New Zealand Standard AS/NZS 4488.1:1997 - Industrial rope access systems - Part 1: Specifications

AS/NZS 4488.1: 1997[128] specifies requirements for materials and hardware for industrial rope access systems including fall protection. The objective of this Standard is to provide the industrial rope access industry and regulatory authorities with a set of performance standards against which the safety and adequacy of hardware used in industrial rope access systems can be assessed.

126 www.astm.org/Standards/E2505.htm
127 www.osh.govt.nz/order/catalogue/industrial-rope-access.shtml
128 www.standardpdfarea.com/asnzs-448811997-p-398834.html

11.4.4 Australian/New Zealand Standard AS/NZS 4488.2:1997 - Industrial rope access systems - Part 2: Selection, use and maintenance

AS/NZS 4488.2: 1997[129] specifies requirements and sets out recommendations for the selection, safe use and maintenance of industrial rope access system components and assemblies, as follows:

(a) *Selection:* Aspects to be taken into account in determining the types of components of the system which would be appropriate to the envisaged usage.

(b) *Safe use:* Requirements and recommendations relating to the safe practices to be followed in the use of components and assemblies.

(c) *Maintenance:* Essential inspection, storage and cleaning practices which are required or should be observed.

Performance requirements for the components of an industrial rope access system are given in AS/NZS 4488.1.

11.4.5 Workplace Safety and Health Council in collaboration with the Ministry of Manpower, Singapore[130]

The Singapore Ministry of Manpower, states:

"**16.1 Industrial Rope Access Systems**

16.1.4 The critical items specific to safe usage of industrial rope access systems include the following:

… Selection of equipment – The equipment used can be determined through the risk assessment process, which must be carried out before each job. The equipment must be compatible, i.e. the safe function of any equipment or component must not affect or interfere with the safe function of another. Equipment that is safe for use in conventional situations may present risks to operators using industrial rope access systems. The manufacturer of the equipment should be consulted to clear any ambiguity or doubt.

16.1.5 Where it is necessary for industrial rope access systems to be used:

…. An industrial rope access system is NOT designed to stop or sustain falls unless combined with a fall arrest lanyard. …".

11.4.6 ANSI 359.8, Safety requirements for fall protection rope access systems[131]

ANSI 359.8 states:

"2.14 rope access fall arrester
A device used by a rope access technician to lock onto the rope to arrest a fall …

3.3
The rope access fall arrester used to connect the worker to the safety line shall meet the requirements of this standard

3.3.1
When used as a component in the safety backup system, the rope access fall arrester shall always be positioned at or above the waist level of the authorized person

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129 www.standard-area.com/asnzs-448821997-p-399423.html

130 Code of Practice for Working Safely at Height, Published in October 2009, https://www.wshc.sg/wps/themes/html/upload/cms/file/Code_of_Practice_For_Working_Safely_At_Height.pdf

131 Draft

3.4
Lanyards used for safety backup in fall access shall be used in such a way that any fall shall not exceed 2ft free-fall and 4kN force

4.7.1
Rope access fall arresters used for safety backup shall meet the requirements of ANSI Z359.1 Section 3.2.6 …".

11.5 ANNEX 5 - Testing Videos

Annex 5 provides links to a number of drop test videos showing back-up devices. However, most do not include much in the way of test rationale and results. It is, therefore, difficult to draw any structured and comparative conclusions:

Drop testing back up devices for rope access use – two person loads
http://www.youtube.com/watch?v=M2a1zdpScPo

Rope access rescue drop tests - Petzl Shunt
http://www.youtube.com/watch?v=Jv-YCRb6xbI

Petzl drop test
http://www.youtube.com/watch?v=2KpU2W8roCA

Petzl ASAP & Absorbica testing 30/01/2012 AID Rope Access
http://www.youtube.com/watch?v=KyTyKbJI2e8

Goblin - Rope fall arrester
http://www.youtube.com/watch?v=thlKlgrDLKA

SAR Rocker rope access/Rescue back-up device Test 1 (and others)
http://www.youtube.com/watch?v=T_BcSEHhJd4

ASAP demonstration, Petzl America HQ
http://www.ropeworks.com/about_video_asap.htm

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