Inspecting

Personal Fall Protection Equipment

This book describes in detail the process of inspecting items of personal safety equipment used for fall protection purposes in the workplace, entertainment/performing arts venues, and also for sport climbing and similar activities, in line with best practice and guidance from the Health and Safety Executive, the Department for Business, Enterprise & Regulatory Reform and other national bodies.

The equipment we consider is generic, so the information applies to any models or brands with similar design which you may own. The sections on legal record-keeping and industrial standards apply only to products being used in a workplace or a for-hire operation governed by UK laws, however the concepts and explanations of what to inspect, how products can be damaged and the suggested ways to manage your collection of PPE applies equally to their use outside the workplace, such as for:-

- Adventure sports training and activity centres, schools and colleges.
- Companies hiring or repairing equipment for use in personal recreation and sports.
- Clubs, rescue teams and individual end-users.

This book contains enough detail to allow a reader to perform inspections in a competent manner, but is limited to items specifically used for protection against falls from height as covered herein. It does not for example include information on other types of safety equipment (for protection against hazards other than falls) and does not seek to replace product-specific training given where the manufacturer demands attendance on a particular approved course. This need for training will usually apply to complex "systems" such as installed fall arrest lifelines, or inspections where a product must be dismantled and components replaced. We cover many of the same techniques (inspection for corrosion, etc.) but we cannot provide instructions that go against restrictions or requirements imposed by a manufacturer. If you wish to inspect these types of device then this book will provide an important reference but you should still contact the manufacturer for details of the certification and training they recommend. Although such training cannot be enforced upon non-workplace users, in some cases it will be impossible to buy spare parts without the agreement of the manufacturer or attendance on their courses.

If you are **not** using your safety equipment in a professional 'workplace' or 'for-hire' setting then many of the legal restrictions don't apply – so some of the initial sections in part 1 can be ignored. However they still apply to equipment manufacturers and retailers (who have to assume the item will be used in a workplace when they sell it to someone) so the markings and paperwork for many items of climbing or adventure sports equipment contain the same information as would be required for 'industrial' PPE. However in most cases there are slightly different standards for 'industrial' and 'sport' equipment, so it's not always legal to use an item designed for mountaineering or rock climbing in the workplace – it can occasionally even be dangerous!

Laws and official standards quoted in this book use different typeface styles to identify them.

A UK law or EC Directive uses indented blue text:-

Work With Cheese Regulations 2009: Reg 5:

> **No person shall intentionally cause cheese to be dropped from a propeller-driven aircraft except during times of conflict.**

A quote from a standard (BS, EN, ISO, etc.) adds italics:-

> *Cheese Impact Testing: 12.3: The cheese to be tested shall be suspended above a flat surface at a height of between one and three nautical miles and allowed to fall vertically. It shall not remain intact. [BS0001:2009]*

Once we've mentioned a law and given it an acronym, it then always appears in small caps:-

The Work With Cheese Regulations [WWCR] were introduced after the 2008 Gruyere Disaster.

We've divided the book into three sections, each with a coloured margin:-

Part 1 covers the basic ideas of inspection, how to implement a system of record-keeping and introduces the basic fault conditions, so should be read first if you're new to the topic. It also explains the legal frameworks of PPE and PFPE as they apply to UK workplaces and product suppliers.

Part 2 covers each type of equipment in detail, describing the things to check and an explanation of the product standards and markings. It's intended as a reference to use when inspecting a particular item.

Part 3 has more information on the standards discussed in parts 1 and 2, plus background information which you will find useful but go beyond what you'd be expected to remember in your head.

We always assume that when inspecting an item of equipment you have access to the official product instructions as supplied by the manufacturer, as these contain important and sometimes legally-binding information about inspection and maintenance. If you need replacement copies they can often be found on the manufacturer's website or supplied by a retailer or distributor of that brand. Selling items without the instructions, even second-hand, is a breach of UK law.

Except in a small number of cases which we will highlight, you do not need access to the BS/EN standards for an item in order to inspect it, nor do you need to be a trained ***user*** of the item. Training as a product ***inspector*** is sometimes required by the manufacturer before they will supply spare parts, but this mainly applies to complicated or 'installed' systems requiring dismantling or routine maintenance. It may sound contradictory, but often the best inspectors are those who don't use the equipment every day – as they have no self-interest in the outcome and don't get over-familiar with the condition of the item. The friend who's most likely to tell you that you're looking old is the friend you only see once a year.

LOLER Thorough Examination Report : Example entry

ITEM	SMZ AbseilMax descender	SERIAL MARK	2045276856
Manufacture date*	WK 24 / 2003	Name/address of owner: Portland Grains and Powders. 21 New Road West Portland Bay Shropshire	
First use date*	10 Dec 2003		
Product lifetime*	5 years max		
Storage location / user	Pool kit, grain silo two, Portland depot		
Product description, colours and markings	Autolock descender for 11mm rope. Marked with green tape.		
Date of last Examination	15 Nov 2006	Safe Working Load	150kg

Type of Examination	6 month routine	Examination Result	PASSED
Defects found (if any): NONE Defect is apotential danger to persons? N/A		Repairs made (if any): NONE	
Testing performed (if any)	Operation checked with sample of 11mm rope.		
Date of NEXT Examination	10 NOV 2007	Date of THIS Examination	10 MAY 2007

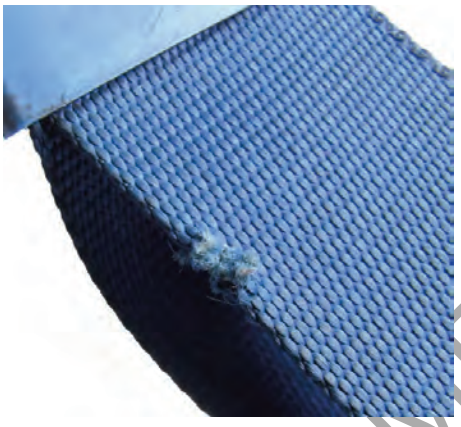
Name of Examiner	Bill Petersen	Examiner's Employer:	
Address of Examiner: 12 Maple Street, East Ridge, Witherington, Shropshire SS01 1SS		Petersen Inspection Ltd. 101 Industrial Way, East Ridge, Witherington, Shropshire SS02 2SS	
Examiner's qualifications	N/A		
Date of this Report	14 MAY 2002	Authenticating Signature	*Janet Jones*
Signed on behalf of Examiner by:	Janet Jones, Petersen Inspection Ltd. 101 Industrial Way, East Ridge, Witherington, Shropshire SS02 2SS		

The above entry shows a typical TE report writeen by an external contractor for a rope access descender, printed on computer and signed by a secretary. Note the lack of any qualifications as there are none for inspecting this type of device.

Wear of textile equipment

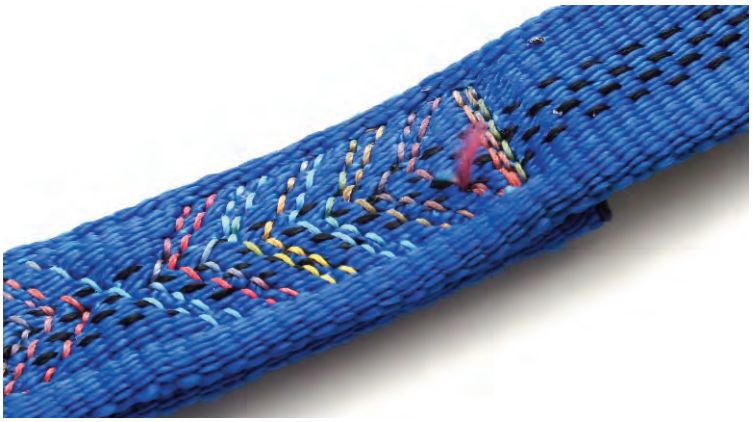
Wear from grit and abrasion is the normal reason for textile items to fail an inspection – internal contamination of rope or webbing with rock particles, salt, ice, mud, etc. will cause gradual cutting of the fibres over time. External abrasion (ropes rubbing over edges, harness leg loops wearing against each other and against tools) is common and any visible damage where the strength and integrity of the textile is thought to be affected would be grounds for disposal. Because of the loadbearing core, a slightly furry kernmantel rope is in itself not a major problem but can indicate similar levels of damage to the core and will make the rope collect far more dirt when in use. Webbing, because it has no inner core, is more of a concern if worn on the surface and your failure point should be correspondingly sooner. Damage to the ***edges*** of webbing is particularly important as it can initiate a bit-by-bit tearing action. We often see individual threads 'pulled' when they are caught on a tool or a sharp snag on metal structures, and while one pulled strand will not change the strength in a measurable way it's still difficult to justify passing the item as undamaged. Sometimes the pulled thread can be eased back into position by pulling and bending the webbing back and forth, but don't be tempted to cut it off!

Both the photos below show failed items.



Stitching needs specific attention, as often it's the area that shows most wear. A webbing sling, harness or even a rope that is sewn with a certified pattern will be stronger than the material itself, provided it's not damaged. The stitch block may use 500 stitches, but it's still made from two strands of thread. Cut them and they unravel! Any break in the loadbearing stitches on harnesses, slings or ropes is grounds for failure, even a single broken thread in the middle of a big panel. There will of course always be some stray ends where the machine started and finished the pattern, as in the photo below, but to make your job easier almost all PFPE textile products use stitch threads that contrast to the webbing or rope they're fixing together [the EN and UIAA standards insist on it]. Some, as the photo below shows, use 'rainbow' thread so it doesn't matter what colour the webbing happens to be.

You can still get black-on-black sewn products, intended for military or tactical use, but the result is a lot more work and eye strain for the inspector. Don't buy tactical webbing unless you need it, or someone else has the job of inspecting it!



Ratchet pulleys

A pulley that includes a rope clamp, and so only allows the rope to move in one direction, is a very popular item both as a personal hauling tool (for arborists, climbers and rope access workers) and as a component in a dedicated block-and-tackle rescue system. As a standalone product they are mostly used to lift equipment rather than people, but they can do that too. There's no specific standard for a ratchet pulley so they tend to be marked with ***both*** EN567 and EN12278.

Adding a rope clamp's mechanism to a pulley is possible in two ways – you can add a complete frame-loaded clamp to one of the pulley cheeks (forming a 'cam follower' as on the left) or you can use the pulley sheave as part of the clamping process by squeezing the rope directly between the sheave and a toothed shoe (forming a 'top-cam' design as on the right). Both have their advantages and disadvantages, but in the UK one brand of compact products using the top-cam principle have dominated the market in recent years. Outside the UK, cam follower devices are a great deal more popular, as in general they have a much higher safe working load.

Apart from inspecting the pulley sheave(s) and cheeks as described earlier in this book, the toothed shoe must meet the same strict criteria on tooth damage and wear as described for frame-loaded rope clamps. Top-cam products are even more important in this respect as often only a few of the teeth will actually bite into the rope, so any damage to them will have a major effect on holding strength.

Remember: The EN12278 maximum load pictogram is only talking about the pulley – when the rope clamp is engaged the maximum loads reduce significantly. This will be explained in the product instructions, but is rarely shown on the product itself. If you're doing Loler paperwork for these type of device (and you should be) then make sure the SWL is explained properly for all possible configurations.

Top-cam ratchet pulleys have quite intricate mechanisms to allow the clamp to be disengaged, and these should be inspected carefully for reliable and correct operation. Although it is rarely possible to deform them, the springs that control these mechanisms are well-hidden and prone to corrosion. In contrast, cam follower devices often have a simple cord or wire lanyard attached to the rope clamp (as in the photo) so that the user can release it from a distance (and without placing their fingers too close to the rope) – these are often the first thing to be lost or damaged, although they can be replaced by a similar piece of cord or string without hitting any type-approval problems.

Accessory cord

The word 'rope' in this book refers to a full-size and full-strength product – but there are many examples of thin cordage used in PFPE, for example as retainers for demountable parts or on harness gear loops. This is called 'accessory cord' and is usually kernmantel produced in the same way as rope, but the with less elasticity. To meet the EN564 product standard it must be in the diameter range 4mm to 8mm and have a minimum static strength as shown in the table. Unlike with rope there is no drop test for accessory cord and so it can be made using low-stretch materials (HMPE, aramids, etc.) which don't have the elasticity to hold a fall. There is no product marking at all for accessory cord, and only the reel or packaging needs to bear the CE marking and strength information.

EN564 / UIAA 102	
Diameter (mm)	Minimum MBS (kN)
4	3.2
5	5.0
6	7.2
7	9.8
8	12.8

Inspecting webbing

Webbing must be inspected for all the general textile issues described in part 1 – chemical damage, wear, deformation, heat and UV exposure – and also the basic PPE criteria of labelling and service lifetime. Webbing has no inner core and so even small amounts of damage to the yarns can have a significant impact on strength. When maintained properly, webbing can last for years even with regular industrial use, but an accidental splash of chemicals or a yarn caught on a rough edge can ruin it in seconds. Anchor slings are therefore the products least likely to see old age, and in many cases their working life is measured in days or weeks. When used for harnesses, webbing tends to last a little longer – if only because the wearer is more careful of what they sit on!

As webbing ages it tends to become fluffy, due to breaks in the individual filaments of polymer. Slight fluffiness is not a problem in itself and will have no measurable impact on tensile strength, but it can be a sign of a more important problem in some cases. UV exposure or machine washing with detergents can cause the same fluffy appearance but also damage the strength of the webbing on a deeper level. If you find a piece of webbing has developed a fluffy surface unexpectedly, it pays to investigate before passing it. Remember simple products such as anchor slings are so inexpensive it's trivial to scrap them anyway.

Acceptable - minor fluffing (left) compared to as-new (right)

Dangerous - broken threads caused by trapping the sling under a heavy object

Silicone rubber sealant marks on a webbing sling - harmless.

The second method is to incorporate a series of pleats into the webbing of each lanyard 'tail', so making it extend under load in the same way as the rip-strip, but without a discrete block of webbing. Typically these styles of lanyard cover the webbing in a loose, elasticated fabric tube to protect them. They are more common in the USA than in Europe, and they have major safety concerns when used in parallel pairs. When they activate a warning label becomes visible to the user, as there is no other obvious effect of a fall.

The final option is to incorporate a device into the lanyard which allows the rope or webbing to slip through when a certain force is applied. This method is most common for mountaineering products designed for the very high force falls in 'klettersteig' climbing [where the route is protected by fixed steel cables]. There is a specific EN product standard for that type of use, EN958:2006, but it does not apply to fall arrest lanyards for use in the workplace even though the allowed peak forces are the same. There are a few industrial lanyards which use the 'slipping rope' method but they tend to be less popular with users due to their extra bulk. Inspection is a little complicated by the fact some designs can be "reset" by the user after a fall – something which is fine for sport mountaineering where you need to continue to use the lanyard, but not in a workplace where the "scrap after one fall" policy applies, so check carefully for signs of friction damage near the brake device!

The EN standards for ***workplace*** fall arrest lanyards are a little strange, as there are two. The energy absorber element is covered by EN355, but the webbing, rope or chain 'tails' connected to it, and the connectors on those tails, are covered instead by EN354:2002. This is partly historical, but also because energy absorbers are sold as individual products. What a user would typically consider to be 'a fall arrest lanyard' is therefore subject to EN354 ***and*** EN355, so will be marked with both.

The product marking must comply with EN365:1992, and the standard numbers must also be shown. Marking occurs only once on 'the lanyard', typically on the energy absorber to keep EN355 happy, but subcomponents within it (such as karabiners) will of course have their own markings as they were bought by the manufacturer as items of PPE in their own right. When inspecting and recording details of a lanyard only the top product-level serial number should be used unless there are components which the manufacturer allows you to change. Almost all industrial lanyards have their connectors permanently fixed in place, but there are one or two which allow the hooks or karabiners to be swapped by the user.

There's a new British Standard for twin-tail industrial fall arrest lanyards (BS8513), which allows several different classes of lanyard based on the weight of the user, each with a different peak arrest force. This UK-only standard directly contradicts EN355 and will cause no end of confusion for manufacturers and users. We advise that you only ever use products complying with the European standards EN354 and EN355, to ensure compatibility with your other PFPE such as your harness and anchor devices.