Standards to reflect on…

Despite the demise of the 1980s fashion for fluorescent clothing, high visibility apparel and retroreflective materials have continued to grow in appeal. Not only are more and more employers providing their workers with high visibility clothing as standard, wearing retroreflective garments and tapes has become the norm when partaking in leisure activities such as cycling or jogging. Of course, wearing flourescent fabric and reflective tape makes the wearer more 'visible' than if they were wearing black or dark colours, but do all high visibility garments meet the same standard?

The simple answer is "no". Europe, the USA, and Australia all have their own safety standards that apply to high visibility and reflective materials. According to one international supplier, the European standard is the strictest, but what does this mean for the consumer? What are the differences in international standards? Are some standards insufficient?

One size fits all?

In Europe, high visibility clothing must be CE-marked. For professional usage this must comply to the EN471 standard and for non-professional use, i.e. for jogging, cycling, motorcycling, etc., the norm is standard EN1150. EN471 is the standard which defines the specification for different levels of reflective materials. The main classification for fluorescent clothing is based on the square metreage of material incorporated into the garment and is categorised into three classes. According to European standards, class 1 garments must include 0.10 m2 of reflective material and 0.14 m2 of flourescent material. Class 2 garments must contain 0.13 m2 of reflective material and 0.50 m2 of flourescent material. For class 3 the standards are 0.20 m2. Garments must also have 50% plus or minus 10% of the total amount of visible background material on the front and rear of the garment.

Although the North American standard, ANSI/ISEA 107-2004, still falls short of the European requirements, following its revision in September 2004, it does set down far more stringent demands than the previous standard ANSI 107–1999. To comply with ANSI/ISEA 107-2004, a garment's background material, and retroreflective material, must be tested and certified by an independent, accredited third-party laboratory, unlike the earlier standards that allowed self-certification of materials. The square metreage of fluorescent/retroreflective materials has also been brought more into line with the European standard. The new version of the standard also states that garments should be selected based on the work environment, the task of the worker, separation of the worker from moving equipment and vehicles, and other work environment variables, which covers far more situations than in the previous standard. The Canadian Standards Association (CSA) is now also in the process of developing a separate high-visibility garment standard for Canada. CSA Z-96 will be established which, while being based largely on the ANSI standard, will address issues that are relevant to the Canadian working environment.

In Australia high visibility clothing must comply with Australian Standard AS/NZS 4602:1999



The Royal National Lifeboat Institute (RNLI) in the United Kingdom – uses reflective materials on its boats, life jackets, drysuits and helmets which need to retain their reflectivity in extreme weather conditions.

RNLI / David Tickner

which must cover all sides of the torso and consist of a minimum visible size of 0.4 m2 (i.e. vest size). Class 1 garments are intended for use in activities that permit the wearer's full attention to approaching traffic, which should be travelling no faster than 25 miles per hour. Class 2 garments are intended for activities where greater visibility is necessary during inclement weather conditions or in more dangerous working environments. This class also covers workers who perform tasks that put them in close proximity to passing vehicles travelling at 25 miles per hour or higher. It is worth noting here that the classification of high visibility clothing in relation to the speed of surrounding traffic was removed from the American standard in the latest revision. Australian class 3 garments are intended for workers who face serious hazards and often have high task loads that require attention away from their work. Garments for these workers provide enhanced visibility to more of the body, such as the arms and legs.

It seems, therefore, that although standards vary, a natural alignment does seem to be developing over time.

A class of their own

In Europe class 1 is rarely used as the level of visibility provided is relatively low, although harnesses and some trousers come into this category. Class 2 covers tabards and waistcoats which include sufficient fluorescent and reflective material to fulfil the metreage requirements for this class. One point worth noting is that in order to achieve classification and the required square metreage, small sizes in these items do not meet standards, which means that in a professional situation women and smaller-built men are forced to wear garments that are too large in order to meet standards, which in itself raises other safety issues such as wearing loose clothing around machinery, etc. This is one reason for the establishment of separate standards for personal use, so that smaller garments for children and women can be regulated. Class 3 covers coats and sleeved garments with a much larger surface area of reflective and fluorescent material.

Due to a change in consumer demands, manufacturers have now introduced more garments known as lightweight high visibility garments (LHVG) in recent years. These garments, such as waistcoats, do not fit any idea of traditional workwear or leisurewear. Although these products still meet EN471 regulations, they are intended to offer a higher level of comfort in a lightweight format. For example, worn over more expensive foul weather garments or uniforms they reduce costs to the company as they provide visibility, but can be replaced more regularly. For example, road workers or those in the construction industry need to replace high visibility garments more regularly due to dirt and staining of the flourescent material which leads to a reduction in the efficiency of the garment.



Praybourne workwear garments incorporate the Pulsarneon electro-luminescent light system which can be activated to flash intermittently or stay constantly bright.

Praybourne

Simon Valentine, general manager of MBS Industrial Supplies, a UK-based supplier of personal protective wear, remarks: "Customers tend to replace high visibilty garments due to staining and dirt rather than fading or wear and tear. On average road workers have to replace garments every two months due to a build up of bitumen, which reduces visibility. For this reason many choose to purchase high visibility waistcoats to wear over regular workwear, which are significantly cheaper than buying coats, trousers and t-shirts made of fluorescent / reflective fabrics."

Quality counts

One standard that covers all European classification is the quality and colour fastness of the fabric used in high visibilty clothing. The three colours acepted for high visibility clothing —satin yellow, fluorescent orange-red and red-— must all meet colour space, luminance, and colour fastness standards, which were revised in the 2003 version of EN471. These stipulations apply not only to new garments but also relate to the level of fading and any diminishment in the level of visibilty through the effects of wear, perspiration, staining, climate, washing and cleaning, etc.

The physical properties of the materials used in high visibility and retroreflective garments have actually been relaxed in the latest standards. The tensile strength of woven materials has been reduced from a minimum of 850N to 450N lengthwise and 650N to 450N crosswise. Bands no longer have to be placed at the same height, upper sleeve bands do not have to be between the shoulder and elbow and there is no maximum height for the band on trouser legs. Bands may now also be placed at an angle of up to 20° to the horizontal.

A certain level of colour fastness is required so that fluorescent and non-fluorescent colours do not bleed into one another thus reducing the effectiveness of the garment as a safety product. Although some level of fading is inevitable, standards require that the product retains an acceptable level of visibility. Suppliers and manufacturers are obliged to issue information sheets with all garments which provide information on washing the garments – including the maximum number of washes — and aftercare. According to these instructions most manufacturers recommend that high visibilty garments are washed on a 40°C cycle or hand washed, although some coats can only be sponge cleaned. They are not suitable for dry cleaning, tumble drying, ironing or bleaching. All of the articles state that they must be clean to be effective and that the garment should be washed a maximum of 25 times before being replaced. Garments bearing the CE mark also warn that any article that becomes permanently stained or faded

Physical Property	EN 471: 1994	EN 471: 2003
Tensile strength of woven materials	Lengthwise: > 850N Crosswise: > 650N	Tensile strength (in N) divided by specific mass (g/m^2) shall be > 2, with a minimum of at least 400N
Bursting strength of knitted materials	> 1000N/m^2	800N/m^2
Tensile strength of coated fabrics and laminates	Lengthwise: > 450N Crosswise: > 450N	Tensile strength (in N) divided by specific mass (g/m^2) shall be > 2, with a minimum of at least 400N
Tear resistance of coated fabrics and laminates	Lengthwise: > 300N Crosswise: > 30N	Lengthwise: > 25N

Source: SATRA

should be replaced. So how does this affect the consumer? A garment that can only withstand 25 washcycles does not seem to be a cost efficient garment for companies equipping large workforces, so do businesses incur high costs due to a lack of longevity? According to Mr Valentine, a 25-cycle lifetime does not affect sales of high visibility garments, "To be honest, I don't think our customers actually wash the garments very often. If a garment becomes soiled, it is usually disposed of as the soiling from oil, cement, and bitumen is too heavy to be removed on a 40° cycle. As the garments are generally worn as outerwear, they do not require such regular washing as t-shirts, trousers etc." However, all CE-marked garments undergo wash tests and can withstand the recommended 25 wash cycles without losing their reflective/high visibility properties, other garments are also specifically designed to withstand industrial cleaning processes.

As far as staining of the products is concerned, manufacturers recommend that garments are kept clean and are stored in non-humid conditions. According to 3M's care guidelines, certain factors such as perspiration, salt water, chlorine, strong acids and sulphur compounds can reduce the effectiveness of reflective tape, although often these stains are caused by the erosion of the aluminium between the glass bead material and are merely cosmetic, not causing any detriment to the reflectiveness of the material.



Extreme conditions

These garments not only have to be washed, they also have to stand up to exposure to extreme weather conditions, chemicals and salt water. However, on the whole it seems that garments are not usually exposed to such extreme conditions long enough for them to cause any real degradation in the effectiveness of the visibility. According to Ron Price, offshore manager at Lloyd and Jones engineers in the UK, who deals with international oil companies, a large percentage of the workforce are contractors, and as a result of this, garments are often only worn for short stretches of time as new clothing is issued for each worker. For those working both on and offshore, it is standard practice for high visibility clothing to be issued on an annual basis.

However, it is not only clothing that has to be visible; retroreflective materials are also used on equipment and this is often exposed to far greater extremes than garments. Safety boats, for example, are often adorned with retroreflective tapes to improve the visiblity. Marine clothing and equipment are covered under the international SOLAS (Safety of Life at Sea) standards, which conform to the International Maritime Organisation (IMO) Resolution A.658 (16) Annex 2 which is approved by the US Coastguard, and the Marine Equipment Directive 96/98/EC standards which cover life support equipment such as life vests, jackets and rafts. These materials are attached to equipment by pressure sensitive adhesive or a sewable backing. So how well do these reflective materials withstand constant exposure to salt water and extreme weather conditions?

According to a mechanic at The Royal National Lifeboat Instiute (RNLI) in the United Kingdom – which uses reflective materials on its boats, life jackets, drysuits and helmets – the retroreflective materials do not show any signs of depleted effectiveness due to this constant exposure. He claims that the last boat based at his station was retired after nine years of service and in that time only one small piece of reflective tape had to be replaced. He adds that this was due to it becoming detached rather than it losing its reflective properties. Manufacturers do warn that some depletion of reflectivity can occur with continued outdoor exposure and wear and tear, but it is doubtful that any consumer can really complain if the RNLI scenario is typical of the endurance of these materials.