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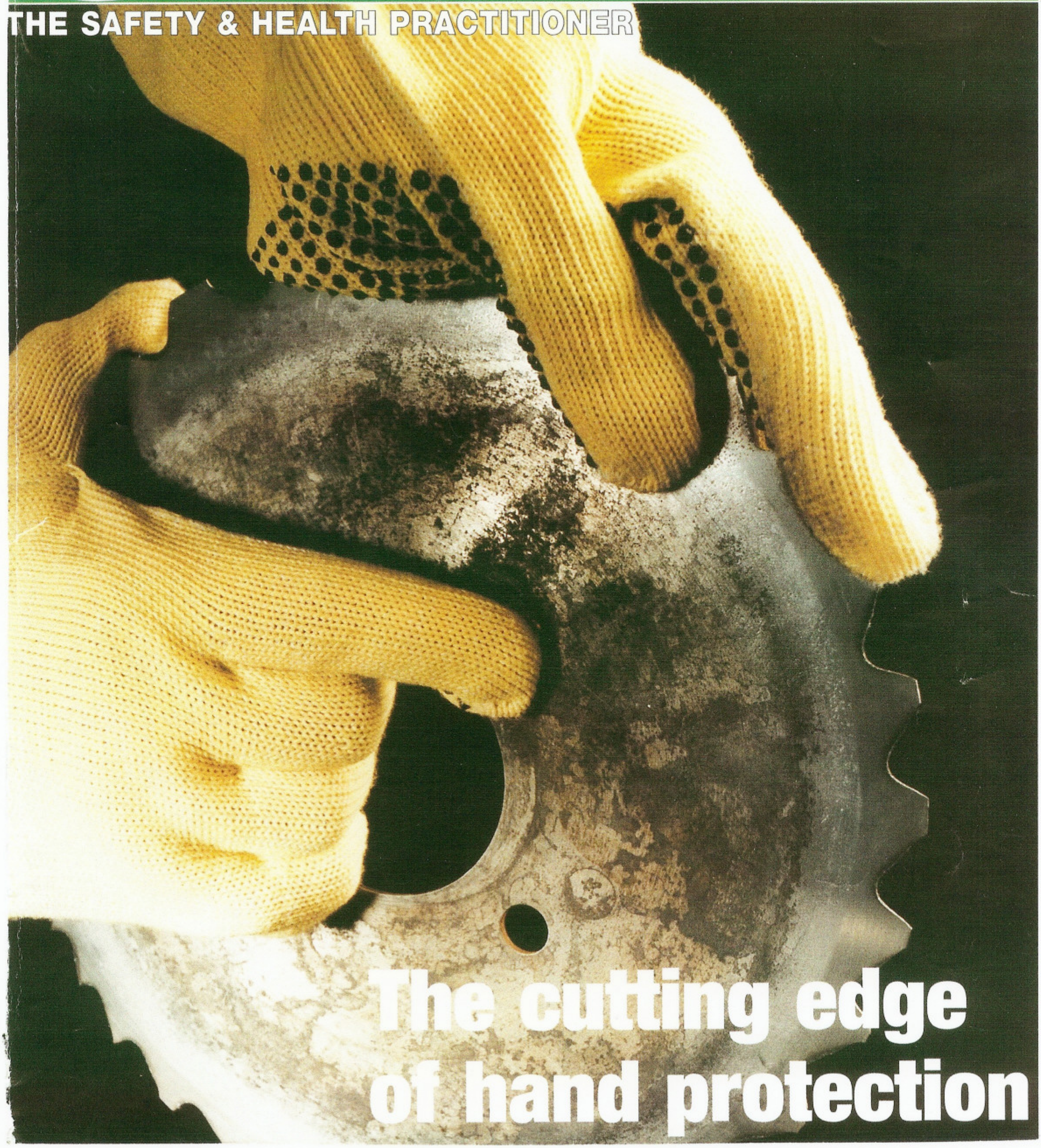


The cutting edge of hand protection

CUTTIN to the quick

Most people will, at some point in their work, use cutting implements, such as knives, scissors, or saws, or have to handle sharp objects, such as nails, glass, or pins/needles, so the potential for cuts and lacerations to the hands and arms is high. Dudley Duncan looks at developments in cut-resistant hand protection in the United States and Europe.

The first gloves designed specifically to prevent cuts, slashes and punctures were of the metal mesh variety. While providing the ultimate in protection these are generally difficult to work in, fit poorly, are heavy to wear and can conduct cold.

While hand protection – gloves of all types – has been around since the Stone Age, there are two classes of glove designed specifically to protect the hands from lacerations that are relatively new. The first gloves designed specifically to prevent cuts, slashes and punctures were of the metal mesh variety. While providing the ultimate in protection these are generally difficult to work in, fit poorly, are heavy to wear and can conduct cold. As "ergonomics" increased in popularity as a concept, companies began to develop yarns that were specifically adapted and designed for the protection of hands from cuts and slashes.

Among the first to be developed were organic man-made fibres, known as beta aramids. The most common name known to all of us is Kevlar®, invented in 1965 by the DuPont Corporation. Because of its superior strength (five times stronger than steel on an equal weight basis), light weight and flexibility, Kevlar quickly found its way into tires, skis, aircraft parts and bullet-resistant vests worn by the military and police departments around the world.

In 1975 a US patent was issued for the use of Kevlar in a glove designed specifically to prevent cuts and slashes in

Photo courtesy of Bennett Safetywear

general industrial applications. This was the first true application of 'high-performance fibres' in the manufacture of cut-resistant hand protection. Gloves manufactured from Kevlar and other high-performance non-engineered yarn – for example, Twyron® and CRF® (Barrier Cut) – are used primarily in the automotive industry, sheet metal fabrication and glass handling/ manufacturing, rather than in food handling operations. This is because food can become trapped in aramid fibre gloves like Kevlar, Twyron and other staple-length fibre yarns, making them difficult to clean.

Through the years, the fibre, yarn and glove industries have continued their search for the ultimate cut-resistant fibre that is affordable and can be used in hand protection. In 1977 a US patent was issued for the first 'engineered yarn', or composite yarn glove that combined strands of stainless steel wire with Kevlar and other synthetic fibres. For applications that required maximum cut resistance, and where metal mesh gloves were not practical, as in some procedures in meat-packing and slaughter-house operations, the engineered yarn styles became the glove of choice.

In 1985 the Allied Corporation in the US developed a long chain polyethylene yarn that is more commonly known today as Spectra®. With properties that include light weight, excellent stretch modulus and high strength-to-weight ratio, Spectra is one of the most widely used high-performance engineered yarns in cut-resistant gloves today.

There are several styles of engineered yarn available and the most common are known as 'core spun'. In a core-spun, high-performance engineered yarn, the core can consist of stainless steel wire, optical fibreglass, and Spectra, Kevlar, or other synthetic fibres. This core is then wrapped using patented methods, again with Spectra, Kevlar, or other high-performance yarns. The engineered yarns are then knitted into hand and arm protection (gloves and sleeves) that now form part of the front line of defence against cuts and slashes in the restaurant, food service and meat processing industries. As an extra

YOU NEED HANDS

The hand is a delicate structure and even a minor injury may take a long time to resolve. Injuries may cause permanent swelling, loss of function, or poor toleration of cold and stiffness. Provisional RIDDOR figures for 1999/2000 show that of all the workplace injuries reported for the year, 16.9 per cent involved cuts or lacerations. Damage usually occurs to one, or more of the following:

Nerves

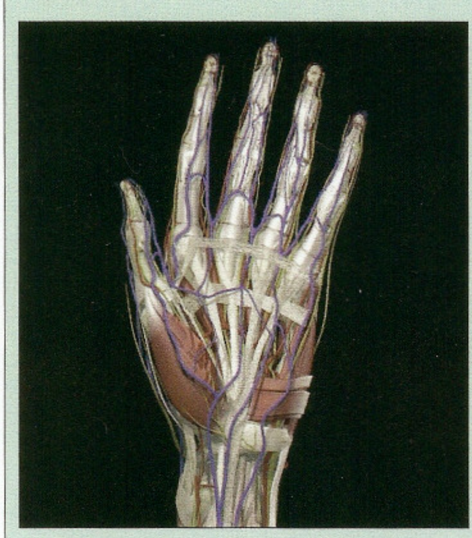
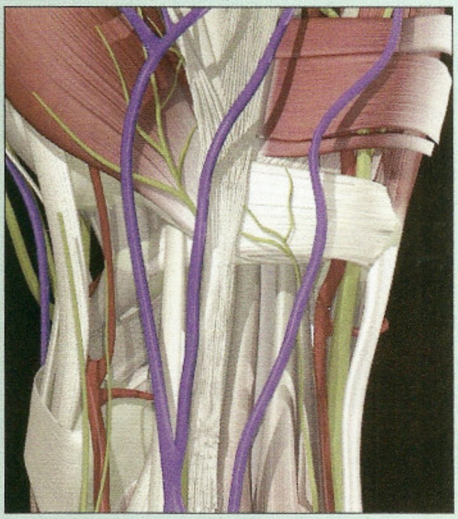
Such damage results from deep cuts and is not always apparent at first. To repair the nerve, the divided nerve ends are sewn together and the hand splinted to ease the repair. The growth rate of nerves diminishes with age so the older the victim, the longer the healing process will take. Sometimes, the nerve may grow out between the two nerve endings, producing a very painful neuroma, which will require further operations.

Blood vessels

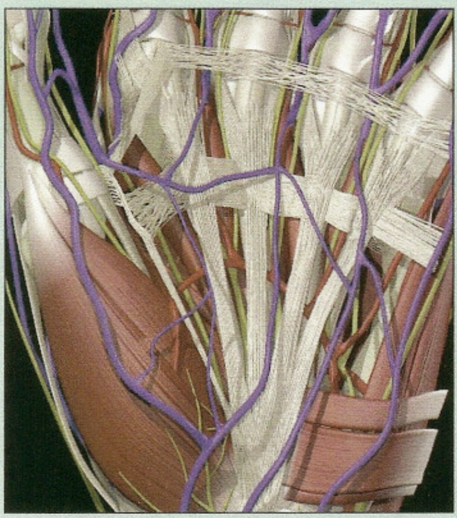
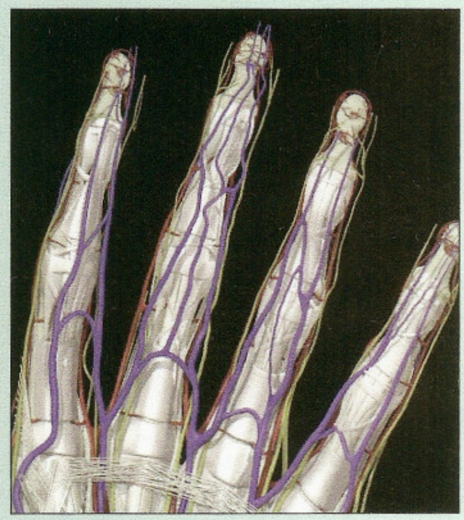
The fingers and the hand itself are both supplied by two arteries and are drained by numerous veins. Severed arteries and veins can be repaired and do require post-operative splinting to assist healing. Vessels can go into spasm after injury, allowing clots to form.

Tendons

Extensor tendons straighten the joints and are situated on the back of the hand, while flexor tendons bend the fingers and are to be found on the palmar side of the hand. Tendon injuries can be repaired but owing to the fragility of the repair, re-rupture can easily occur in the first few weeks. Post-operative splinting and physiotherapy is therefore very important. Splints have to stay on for anything up to eight weeks. After removal, the joints are stiff and usually require extensive physiotherapy to regain a full range of movement.

Although everyone is different each hand contains, give or take, 29 major and minor bones, 29 major joints, at least 123 named ligaments, 34 muscles (17 in the palm of the hand alone), 48 named nerves (three of them major), 30 named arteries and nearly as many named branches

3-D images courtesy of the Interactive Hand, from Primal Pictures Ltd.

It must be recognised that no particular glove can, or will provide 100 per cent protection. Each individual wearer, in accordance with his or her job requirements, determines glove selection. Performances will vary according to the application.

benefit, manufacturers can add anti-microbial protection to fabric-style gloves that will last the life of the glove.

Testing methods and standards

In an effort to set effective standards and test methods for personal protective equipment (PPE), the Council of the European Communities established Directive 89/686/EEC as a harmonised testing for PPE.

Hand and arm protection are tested in accordance with European Standards **EN 388: Mechanical Test Methods and Specifications**, and **EN 420: General Requirements**. The resulting levels of protection determined by these PPE tests are contained in a technical file for each product, which is held by the manufacturer and is available for inspection, upon request. Each item of PPE must be marked with the CE mark as a condition of sale in Europe and in other countries that have chosen to recognise the CE testing requirements.

The United States began the process to establish a uniform national testing standard in the late 1990s. The American Society for Testing and Materials (ASTM) devised **ASTM 1790.97, Standard Method for Measuring Cut-Resistance of Materials used in Protective Clothing**, which established test standards for cut-resistance. After reviewing the ASTM testing methods, the American National Standards Institute (ANSI), working with The Safety Equipment Association (ISEA), established the **ANSI/ISEA 105-2000** standards and classifications. These cover the testing of hand protection for specific performance properties related to chemical and industrial applications.[1] The standard provides US manufacturers with a mechanism to classify their products for specific areas of glove performance, though it is up to the individual manufacturer to determine which of the tests outlined in the standard to use.

While many of these testing methods are unique to the US, some provisions of the CE testing requirements are used. For example, to measure cut resistance of PPE the United States uses ANSI/ISEA 105-2000 and ASTM 1790-97 with levels of protection (classifications) that are similar to those of EN 388. For puncture resistance of PPE, EN 388:1994 clause 6.4 is used as the testing standard, along with similar classifications. It is not known why this particular test method is used in the US but one possible reason is to achieve homogenisation between European and US testing standards. Many US PPE manufacturers sell their products worldwide, so the inclusion of the CE standard indicates a move towards a general worldwide standard.

The US currently has no specific marking requirements for products that have been tested to these ANSI standards. Indeed there are no requirements at present to test these products against any specification – manufacturers are currently carrying out

Table 1. Metal mesh versus high-performance and engineered yarn fabric gloves

	Advantages	Disadvantages
Stainless steel metal mesh	• Highest level of protection available • Provides point puncture protection • Easily sanitised and cleaned • Cost-effective when properly maintained	• High initial purchase cost • User dexterity and comfort can be compromised • Ergonomic considerations in proper fitting of glove • Repair costs and turnaround time
High-performance and engineered yarn fabric cut-resistant gloves	• Cost-effective in many "less hazardous" environments • Initial purchase cost • Excellent flexibility, dexterity and touch sensitivity • Excellent fit, providing ergonomic benefits • Lightweight	• Will not protect against point punctures • Requires greater care in sanitising and cleaning • Cannot be repaired • Less cost-effective if not properly cared for

tests on a voluntary basis. Many now mark their PPE with the appropriate CE certification mark. While not expressly required in the United States, manufacturers there believe that using the mark facilitates non-biased performance comparisons between products. Most agree that a uniform test method is desirable and politics is playing a significant role in getting the industry to agree to a marking requirement.

While Table 1 (above) contains a partial listing of the advantages and disadvantages of the various styles and versions of cut-resistant hand protection, it must be recognised that no particular glove can, or will provide 100 per cent protection. Each individual wearer, in accordance with his or her job requirements, determines glove selection. CE and ANSI standards are designed to give the consumer a means to compare styles and manufacturers. Performances will vary according to the application. When a style has been determined as appropriate for the job it is recommended that the gloves be thoroughly tested in that application to determine their suitability.

Notes

1 Information taken from ANSI/ISEA 105-2000 booklet, *American National Standard for Hand Protection Selection Criteria*, approved 25 February 2000

- Kevlar® is a DuPont registered trademark
- Spectra® is a Honeywell registered trademark
- CRF® (Barrier Cut) is a Honeywell registered trademark
- Twyron® is a registered trademark.

About the author

Dudley Duncan is vice-president and owner of California-based Double "D" Knitting and Glove, Inc and has worked in safety equipment manufacturing for more than 20 years. He has sat on the Board of Directors of the (US) National Industrial Glove Distributors Association for the past three years and is a member of the American Society of Testing and Materials committee responsible for writing and establishing test methods for cut-resistant gloves.