

2008

Making Sense of Cut Resistance



“Cuts, slices and abrasions account for almost 30% of the lost time and productivity in the US.”

Rob Vajko

10/2/2008

Understanding Cut Resistance

Cuts, slices and abrasions account for almost 30% of the lost time and productivity in the US. Most of these (almost 80%) involve hands. Making sense of cut resistance, however, continues to an allusive task. Knowing the actual level of cut resistance is further complicated by the fact that many glove manufacturers make claims about the level of cut-resistance without having any third party documentation to back up the claims.

The purpose of this paper, therefore, is to try to wade through all the terms, all the fabrics and all the different types of cuts in an effort to try to make sense of cut resistance and help employers and employees cut down (no pun intended) on cut injuries.

Types of Cuts

Slicing – Caused by the sliding of the skin across a very sharp edge. The sliding action can be a result of the hand or other skin surface sliding across the sharp edge or by the sharp edge sliding across the stationary hand or other skin surface. Examples of this type of cut would be a slip of the knife when dicing vegetables.

Abrasions – This type of cut is the result of continuous or repeated “rubbing”. The surface may or may not be sharp or jagged.

Punctures or impact cuts – These are the result sharp or pointed objects impacting the skin as in a falling pane of glass or sheet of metal. Needle sticks would also fall into this category.

Protection issues

It would be a relatively simple procedure to protect against cuts and abrasions if it weren't for the issue of mobility, flexibility and comfort. A solid steel glove would provide great protection but would keep the worker from being productive. Because we want, not only to protect the worker but also to allow him to continue to do the work he is doing with a minimum of discomfort and mobility restriction, however, we have found ourselves, over the years, trying to develop different cut-resistant fibers and materials that will restrict movement to a minimum and yet still provide the best possible protection. Leather was, for years, the best protection against these types of injuries but the best protection called for thicker leather which left the users with a minimum of dexterity and virtually no sensitivity. Other fabrics and fibers, developed over the years have increased dexterity and allowed for more flexibility without compromising protection.

Understanding the technology of composite fibers

Composite fibers, also known as engineered yarns, are fibers that are made of two or more components. Kevlar Steel is a good example of this type of composite fiber. Kevlar steel yarn is simply a yarn that is made up of a steel core with a Kevlar coating on it. Additionally some “Advanced Composite Yarns” have one or more high strength synthetic yarns coiled around the Kevlar to provide a “rolling” action (the fiber acts something like a ball bearing by rolling the blade away) or a lubricating action (which allows the blade to “slip” off).

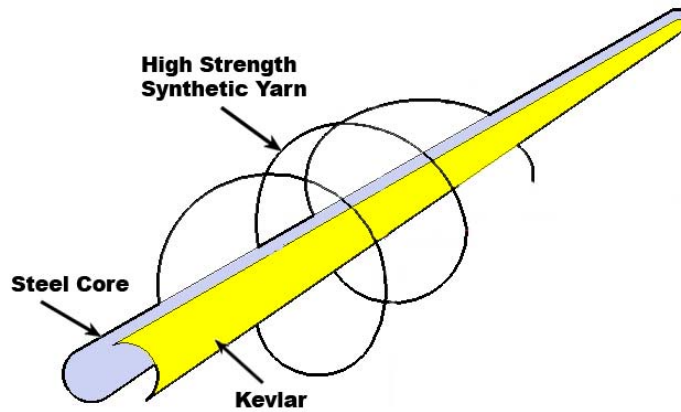


Image A

Types of Fibers and Fabrics

ATA – (Advanced Technology Aramid) A high performance fiber that combines several aramids and synthetic materials. It is about 12 times stronger than steel.

Dyneema – A Lightweight, extremely tough polyethylene fiber that is 15 times stronger than steel. It is extremely durable and water resistant. It holds up well to UV light, chemicals and humidity.

Fiber-Metal Blends—Blend of woven fabric and stainless steel (See image A).

Hexarmor – Hexarmor uses SuperFabric® Brand Technology to create hard plates that are attached to fabrics (see image B below). Multiple, staggered layers offer the highest levels of needlestick and sharp protection available (see image C below).



Image B



Image C

Kevlar – A Synthetic fiber (also known as an “aramid”) that is five time stronger than steel and extremely heat resistant.

Leather – Leather actually shouldn’t even be on this list. I only include it because one of the most common misconceptions, when dealing with cut resistance, is that leather is a good cut resistant material. While it is true that an extremely thick leather glove will provide some degree of cut resistance, pound per pound cotton actually has a greater cut resistance than leather. While it is true that leather is superior to cotton and even to Kevlar when it comes to abrasion, it isn’t generally a good choice as a cut resistant glove because, in order to have any degree of protection, the leather has to be so thick that it becomes a very uncomfortable glove that leaves you with little dexterity.

Metal Mesh – Stainless Steel interlocking mesh which offers great cut resistance.

Spectra – A Polyethylene fiber that is 10 times tougher than steel per unit weight. Extremely cut-resistant.

Steel Core – Any number of different fibers contain a steel core (See image A).

Twaron – Lightweight para-aramid fiber (poly-paraphenylene terephthalamide) that is 5 times stronger than steel

Vectran – is a multifilament year spun from liquid crystal polymer (LCP). It is five times stronger than steel.

Note: Many of the cut levels given above were given by the manufacturer of the fabric. Not all have been third party tested and not all provided the data to support the cut level claims that they made.

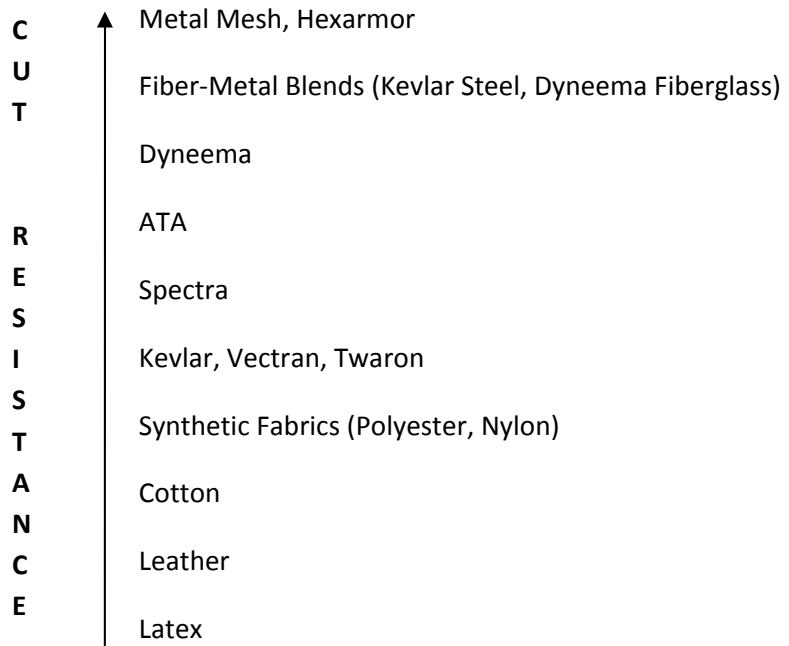


Chart of Cut Resistance Levels

How the cut resistance is determined

There are presently 3 different methods used to determine cut resistance: ASTM F1790 (the standard for the U.S.), ISO 13997 (The international standard) and EN 388 (the European Standard).

The ASTM F1790 and the ISO 13997 test methods use the CPP and TDM test method which consists of a straight blade that is slid along the length of a sample with three different weights. The sample is cut five times and the data is used to determine the required load needed to cut through a sample at a reference distance of 20 mm (0.8”) (See Figure 1 below).

The EN 388 test method uses the Couptest which consists of a circular blade with a fixed load that is moved back and forth across the fabric to determine how long it takes to cut through. Again, 5 cuts are used to determine the cut index (See Figure 2 below).

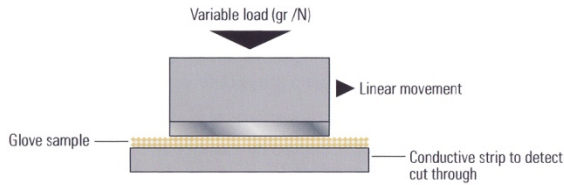


Figure 1 - TDM Method

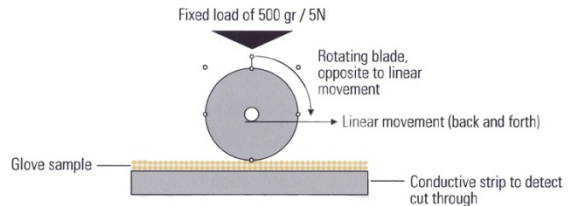


Figure 2 - Couptest

ANSI/ISEA 105 is another performance test that is often referred to by manufacturers. The chart below shows what this rating is:

ANSI/ ISEA 105-2005 Mechanical Ratings:							
Rating	Level 0	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6
Abrasion Resistance* (Cycles)	0-99	100-499	500-999	1000-2999	3000-9999	10000-19999	20000 +
Cut Resistance (Grams)**	0-199	200-499	500-999	1000-1499	1500-3499	3500 +	-
Puncture Resistance (Newtons)	0-9	10-19	20-59	60-99	100-149	150 +	-

* Abrasion ratings 0 through 3 are based on measurement with a 500-gram load. Levels 4 through 6 are measured with a 1,000-gram load.

** Weight needed to cut through material with 25mm of blade travel

While it is certainly acceptable to use this rating (rather than using an absolute value) it remains a pretty relative measurement because of the range involved. For example a glove that gets a rating of 999 is rated as a level 2. A glove that is rated at 500 is also rated as a level 2. A glove that is rated at 1001 is rated as a Level 3 and yet the difference between the first two gloves is substantially larger than the difference between the last two.

Understanding the problem

As we can see from all the different testing methods and standards, cut resistance ratings continue to be one of the most ambiguous rating systems around today.

Additionally, several changes in recent years, primarily to the ASTM F1790 test method, and a lack of proper correlation between the different methods of testing have led to quite a bit of confusion with regards to cut resistance ratings.

When comparing the cut resistance of two fabrics it is important to make sure that:

1. The same test method was used
2. The same type of cut tester was used
3. The same fabric weight was tested

Unless all three points above are met, the results will be hard to compare accurately.

Ideally, what needs to happen is to get a third party tester who can test all the different fabrics independently to determine a true cut resistance rating.

Putting it all together

The nature of the fabric or material, while certainly one of the most important factors involved when speaking about cut protection, is not the only one. Other factors that will come into play involve:

1. The weight of the material (oz/yd²)

A thicker Kevlar material will have a high cut resistance because there is more material to cut through before the skin can be reached.¹

2. The fabric construction

The tightness of the weave, the thread count and how the material was made will all affect how cut resistant a glove or fabric will be.

3. The coating

The type of coating that is applied to the fabric (nitrile, latex, etc...) will usually increase the level of cut-resistance. It is also important to realize that some coatings may actually decrease the cut

¹ Be careful with this, however. A thicker glove might, in actual fact, increase rather than decrease the hazard. A thicker glove may not allow the worker to work comfortably or with the required dexterity.

resistance of the fabric.

4. **Conditions at the job site**

Chemicals, dirt, humidity, heat, etc... can all affect how well a glove performs. While a glove that stands up well to grease might actually help the cut resistance rating other chemicals and environmental issues might hinder the cut resistant properties of the fabric.

You will ultimately have to determine for yourself which gloves are going to work for your specific application. There is no single glove that will always work in every situation. A glove that might work well in one instance may not work at all in another. Matching the glove to the job in order to reduce the number of injuries will take time and work. Fortunately, we can help there as well. Below is a step-by-step guide.

A step-by-step plan for making sure that you get the right cut resistant glove

Whether you are trying to select cut resistant gloves because of a new procedure or trying to reduce the injury rate that you are presently experiencing, you need to follow a step-by-step process to ensure that you end up with the best glove possible.

Step 1 - Evaluating the present product and situation

Before you can solve a problem, you have to have a clear understanding of what the problem actually is. For this you need to gather data. Accurately tracking when the injuries occur, where they occur and how they occur is the type of data that you will need in order to move on to step 2.

What is the cut resistance level of the gloves you are presently using? Are the gloves actually being worn? If not, why not?

These are the types of questions that you need to be asking. A clear understanding of the nature of the problem is always the first step.

Step 2 - Analyzing the data

Where are most of the injuries happening? Is there a specific time of day when there are a lot more injuries? Are certain workers getting injured more than others? Are the gloves that you are presently providing not being worn because they are itchy or uncomfortable?

Step 3 - Identifying solutions

Is it possible to engineer the problem away? Would a blade guard reduce injuries? Would breaks in the routine helps?

Increasing the level of cut resistance in the gloves may not be the best or only solution. Maybe a more comfortable glove that the workers will actually wear would solve the problem.

Step 4 - Trying out the solutions and/or the new products

Use several different cut resistant gloves and measure the results. Implement the changes that you identified and see what seems to be most promising. Track your results over time.

Step 5 - Repeat

Repeat steps 1 – 4 until you feel you have made the appropriate changes and reduced the injuries as much as possible.

Other points:

- **Get everyone involved**
If many hands make light work, then putting our heads together helps us come up with new and more creative solutions.
- **Use manufacturer reps and distributor sales people**
Getting manufacturers and local safety supply distributor reps involved means that you will be exposed to a broad range of products rather than having one manufacturer rep trying to force a fit with a product that he might have. Do some research. There might be a product out there that you didn't know existed.
- **Be creative and step back from time to time**
Get a fresh perspective, be creative, try something different,... these will help come up with solutions and answers that might otherwise elude us. All great changes came about because someone thought up something new and different.