UNDERSTANDING CUT PROTECTION

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Cut Resistance is often the primary factor considered when evaluating gloves for cut protection because it can be easily measured using standard devices such as the Cut Protection Performance Test or CPPT. However, if you only consider cut resistance when selecting hand protection, you are missing a larger part the cut protection story. For instance, no cut protective product works unless workers comply with safety requirements and wear the garment. Comfort, an Ansell hallmark that is recognized in the industry, plays an important part in compliance and hence in cut protection. In the discussion points that follow, you'll learn more about the difference between "cut protection" and "cut resistance" to more effectively evaluate cut protection.

This guide provides an introduction to this technical topic, but it does not and cannot include the answers to all possible questions. Much work still needs to be done. Ansell's Occupational team works closely with leading universities, agencies, and organizations to improve the testing procedures for cut resistance and establish a better understanding of the factors that influence cut protection and worker safety. The team is also working on methods to identify and quantify cut risks in various customer environments. Included on the Ansell team are scientists who are developing new procedures for testing the cut resistance of textile yarns and fabrics.

What is cut protection?
Cut protection is the combination of influences that tend to prevent a worker from being cut. Material properties such as cut resistance tear strength, and abrasion resistance as well as properties such as grip and dexterity are all important aspects of cut protection. However, cut protection also includes other factors not related to protective apparel such as machine guarding, workplace set-up, working conditions, and worker training.

Ansell Occupational can participate in your cut protection program by providing you with appropriate gloves and sleeves and consulting services based on Ansell's collective experience. Ansell staff can also be available to assist with on-site training. Our Territory managers are prepared to work with account utilizing the Ansell Guardian^{SM} process. (The Ansell Guardian^{SM} process is discussed in more detail later in this document.)

How is cut resistance different from cut protection?
Cut resistance, defined as the ability of a material to resist damage when challenged with a moving sharp edged object, is only one component of cut protection. Because cut resistance can be measured using standard testing equipment, it's often used when comparing the safety of various products. However, as discussed above, more than just the material properties of the glove or garment (i.e. cut resistance) must be considered when evaluating cut protection.

How is protective clothing evaluated for cut resistance?
In the **European** market, gloves are evaluated according to EN 388, the mandatory performance standard for all gloves as standardized and regulated by the CEN. The method uses a constant weight on a circular blade that is moved back and forth across a specimen by the test machine. The machine also rotates the blade against the direction that it is being moved, which intensifies the slicing action.

The CEN method is not well-suited for highly cut-resistant fabrics, especially those that contain glass or wire reinforcement. On those fabrics, the blade is rapidly worn dull during the testing and the data tends to over-estimate the cut resistance.

In the US an entirely different method was developed by ASTM, method F1790. It has been adopted by ISO as an international standard.

Before 2004, previous versions of this method called for a report of load that causes cut through in one inch (25 mm, not 20 mm). When comparing data, be certain that all of the tests were conducted according to the same edition of the standard. ASTM F 1790-97 is the older version that uses the longer cut distance and is still referenced by ANSI/ISEA to determine the performance levels of gloves.

More detailed descriptions of the EN and ASTM test methods can be found on attachment B, "EN 388 and ASTM F1790 test methods."

How much variability is there in ASTM or ISO cut resistance test data?
Yarns, knitted gloves or coated PPE tend not to be extremely homogeneous by nature and therefore promotes a degree of variability in cut resistance data. The measured cut resistance of a specimen can vary depending on exactly where the cutting blade is placed on it and on which direction the yarns run under the contact spot. There are many factors that can contribute to variation in cut testing, and one of our top research goals is to identify and correct as many factors as possible.

This guide includes a table of cut resistance data and ratings for Ansell gloves. The averages are reported and are used to rate gloves according to the ANSI/ISEA scale from 0 to 5. Due to inherent variation (as discussed above) these ratings can provide only a general indication of the cut resistance of any protective material. These values also reflect laboratory measurements, and may vary depending on the specific work environment, materials, sharpness of the blade or edge, and the force applied.

What other glove properties are important in evaluating cut protection and choosing gloves?
The importance of ***Grip*** is apparent once you consider that sharp-edged objects pose a much greater threat when they are in motion. A secure grip when combined with the proper level of cut resistance can significantly reduce the chance of cut injury by preventing slipping and slicing, decreasing the grip force required during a task, and providing the wearer with more control.

Abrasion Resistance and ***Durability*** are both important factors when choosing cut protection. Most products are used for extended periods of time, and it is important to ensure that they provide the same level protection at the end of the shift as they did at the beginning.

Dexterity and ***Comfort*** will also be important in some workplaces where small sharp objects must be handled or the gloves need to be worn for extended periods of time. In a recent Frost and Sullivan survey 85% of the respondents said that comfort is the leading feature that influences their hand protection decision. When hand protection is deemed unsuitable the biggest problem identified by 55% of the respondents is that the gloves "hinder my touch." In the same report Ansell was identified as the highest rated company offering hand protection products in the categories of comfort and ease of use. Comfortable hand protection products that are easy to use mean that workers are more likely to use the recommended hand protection product. In the case of cut protection Ansell can play a significant role in keeping workers safe because they are more willing to wear comfortable, easy to use products.

Some gloves may be worn for more than just cut protection. The people who select them may need to consider protection from ***other hazards*** such as high temperatures or chemicals.

All of these factors, along with environmental factors at individual work places, are to be addressed by the Ansell cut protection team as they form their agenda to better understand Cut Protection.

How are gloves evaluated for grip?
Ansell has been developing products with enhanced grip features as well as working to develop improved test equipment to compare the grip capabilities of various gloves. To demonstrate the differences in grip among gloves: install a pole vertically on a circular base or similar support. Ballast the pole with enough weight to make it hard to lift. If you wish to demonstrate oil grip, lubricate the pole with an appropriate grade of oil. Have the test subject try on several gloves and attempt to lift that pole while wearing each of them. Differences in the required grip strength and the feeling of hand fatigue when lifting the pole in a controlled manner while wearing the different gloves will be readily evident.

Of course a better grip can improve other properties in addition to cut protection. A reduction in grip force means a reduction in work effort by the individual. This improves workplace ergonomics and can have a very positive effect on the reduction in repetitive motion injuries. Ansell Grip Technology™ is a key process platform that Ansell has invested in. For more information on testing and evaluating Grip, please log into Alphatecgloves.com.

How can Ansell help you improve cut protection in your workplace?
Ansell Occupational can contribute to your cut protection program by providing you with appropriate gloves and sleeves. Ansell associates may be able to help in other ways too. Field Territory Managers have visited many worksites and can advise you on the other aspects of cut protection. They may not be primary experts in areas such as adequate lighting and machine guarding, but they can often notice potential problem areas before an accident happens. They are trained to help you pick the right gloves, and are backed by technical experts in all areas of hand protection. A glove survey by one of these Territory Managers is often a good idea.

The Ansell Occupational team can participate in your cut protection program by providing consulting services and on-site training based on Ansell's collective experience. A key contributor, the Ansell Guardian℠ process, is designed around seven key cost saving practices and incorporates tools to capture such information as:

- User Applications and Product Needs (SafetyNet Data)
- Safety and Injury Related Data
- Current Product Information
- Non - Compliance Issues
- Training Opportunities
- Ergonomic Risks
- Process Waste Reduction
- Efficiency improvement opportunities
- Controls (Laundering, Recycling, Dispensing, Disposal Information)
- Inventory Management and Standardization across a single plant or multiple plant locations

For more information contact a member of the Ansell Cut Protection Team at 732-345-2122.

Cut Protection Glossary

Organizations

- **ANSI** – *American National Standards Institute*. A society of standardization societies which approves official American National Standards and which represents the USA in international standardization efforts.
- **ASTM –** still officially *American Society for Testing and Materials*, but they now recruit members from other countries and prefer to be known by just the initials. The largest single standards-writing body in the USA, a society which has over 130 technical committees covering a wide variety of topics. ASTM F23 is the Committee on Protective Clothing.
- **CEN –** *Comité Européen de Normalization*, European Committee for Standardization. The standards that they write are mandatory for products sold in the European Community.
- **ISEA** – *International Safety Equipment Association*. A society of manufacturers and other suppliers of safety equipment which writes ANSI-approved standards for these types of products.
- **ISO** – *International Organization for Standardization*.

Test Methods

- **ANSI/ISEA 105**, *American National Standard for Hand Protection Selection Criteria*
- **EN 388**, *Protective Gloves Against Mechanical Risks*
- **ASTM F1790**, *Standard Test Method for Measuring Cut Resistance of Materials Used in Protective Clothing*
- **ISO 13997**, *Protective clothing — Mechanical properties — Determination of resistance to cutting by sharp objects*

Testing Equipment

- **CPPT** – *Cut Protection Performance Tester*, the device used in ASTM F1790
- **mCPPT** – *Modified Cut Protection Performance Tester*, a modified version of the CPPT used for testing materials with high friction in ASTM F1790
- **TDM-100** – *Tomodynamometer*, the device used in ISO 13997 and ASTM F1790-05.
- **COUPTEST** – the device used in EN 388.

General Terms

- **Cut Resistance –** From ASTM F1790-05, "the property that hinders cut through (the penetration of the cutting edge entirely through material) when a material or a combination of materials is exposed to a sharp-edged device"
- **Cut Protection -** the combination of influences that tend to prevent a worker from being cut.
- **Load** – a force placed on an object. In this context, the force placed on a blade to press it against a specimen of glove or protective clothing material.
- **Rating Force –** From ASTM F1790-05, "the load required for the cutting edge to travel 20 mm and achieve cut through". For ASTM F1790-97 the distance is 1 inch (25 mm).
- **Cut Index** – the value for cut resistance as calculated in EN 388.

- **Repeatability** – the minimum difference required between sample means for two samples tested by the sample lab to be considered statistically different.
- **Reproducibility -** the minimum difference required between sample means for two samples tested by different labs to be considered statistically different.

Products that provide "cut resistance" and "cut protection" do not completely prevent or eliminate the potential for cuts or punctures, and are not intended or tested to provide protection against powered blades or other sharp or rotating equipment. Users are encouraged to always use caution and care when handling sharp materials.

Cut Protection Rating Scales

ANSI/ISEA 105

Rating Force in grams-force, gf (ASTM F1790-97)	Performance Level
<200	0
=200	1
=500	2
=1000	3
=1500	4
>3500	5

Rating Force in grams-force, gf (ASTM F1790-97)		Performance Level
<200	(0-199)	0
=200	(200-499)	1
=500	(500-999)	2
=1000	(1000-1499)	3
=1500	(1500-3499)	4
>3500	(3500+)	5

EN 388

Cut Index	Performance Level
1.2	1
2.5	2
5.0	3
10.0	4
20.0	5

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Attachment A

CPPT Data and ANSI/ISEA Performance Ratings For Ansell Cut Resistant Gloves					
Style Number	Product Description	ASTM F 1790-97 (CPPT) grams			ANSI/ISEA Performance Rating
		Mean Value	Maximum Value	Minimum Value	
74-401	Black Bear® Supreme	6714	7572	5529	5
74-301	Polar Bear® Supreme	6515	7649	5530	5
74-027	Polar Bear®PawGard® Heavyweight	4940	5534	4278	5
70-745	Pulp N' Paper	4746	5365	3982	5
72-023	SafeKnit® Max	4642	5385	4082	5
74-048	Polar Bear®PawGard® Mediumweight	3690	4459	2507	5
74-601	Polar Bear® Cub	3868	4214	3332	5
74-035	Polar Bear® Plus	3670	4222	2900	5
75-781	Vantage® Terry Heavyweight	3272	3694	2858	4
70-024	SafeKnit® Ultra	3118	3495	2757	4
75-780	Vantage® Terry Heavyweight	3034	3813	2601	4
74-025	Polar Bear®PawGard® Lightweight	3019	3402	2476	4
70-700	Armorknit™ Mediumweight	2857	3205	2383	4
70-761	Vantage® 10 Gauge Mediumweight	2625	3203	2224	4
74-071	Teddy Bear™ Lightweight (Gray)	2566	3663	1998	4
11-501	HyFlex® CR+	2405	2760	1871	4
70-765	Vantage® 10 Gauge w/Leather Pad	2253	2627	1787	4
70-860	Vantage® 10 G Mwt. w/Dyneema®	1879	2164	1653	4
75-500	Twaron® Terry	1821	1925	1679	4
72-015	SafeKnit® DT Ultima	1725	1987	1469	4
74-074	Teddy Bear™ Ultra Lightweight (Gray)	1708	1997	1399	4
75-200	Kevlar® Terry Loop-in Heavyweight	1631	1746	1480	4
74-045	Polar Bear® Plus Knifehand	1600	2189	1172	4
70-225	Kevlar® Heavyweight	1586	2034	1072	4
74-047	Polar Bear® Plus Lightweight	1570	1918	1277	4
75-210	Kevlar®-Cotton Terry Loop-out Hwt.	1550	1833	1283	4
74-046	Polar Bear® Plus Knifehand	1455	1863	1125	3
72-025	SafeKnit® Ultralight	1213	1412	1011	3
70-201	KV744 Kevlar®-Nylon Mediumweight	1209	1363	1044	3
70-215	Kevlar® Mediumweight	1139	1556	846	3
28 Series	NitraSafe®	1104	1517	792	3
28 Series	Grab-It Safe®	1069	1169	919	3
70-282	The Bull™	1062	1144	909	3
75-300	GN8354 Kevlar® Terry Loop-out Hwt.	1058	1289	825	3
80-600	Powerflex® Plus	996	1341	789	2
70-330	Kevlar® Mediumweight - Dotted	993	901	1112	2
28 Series	NitraSafe® Foam	925	1335	723	2
28-507	Metalist® Foam	775	941	590	2
70-200	Kevlar® Lightweight	771	1116	515	2
70-320	Kevlar® Lightweight - Dotted	739	846	549	2
16-213	Golden Grab-It® II (Gauntlet)	675	806	509	2
28-407	Metalist®	655	804	534	2
16 Series	Golden Grab-It® II (Palm Coated)	638	870	577	2
11-500	HyFlex® CR	607	859	499	2
11-624	HyFlex®	544	697	451	2
16 Series	Golden Grab-It®	520	621	433	2
70-400	Kevlar® Kleen Lightweight	499	575	405	1
11-627	HyFlex® CR2	476	692	403	1

The table above provides cut resistance data and ratings for Ansell gloves. Data was obtained according to ASTM F1790-97. The averages are reported and are used to rate gloves according to the ANSI/ISEA scale from 0 to 5. Individual specimens will obviously have greater or lesser cut resistance than the average, so these ratings can provide only a general indication of the cut resistance of any protective material.

The standard laboratory test method may not adequately replicate any specific conditions of end use. Because Ansell has no detailed knowledge of or control over the conditions of end use, any recommendation must be advisory only, and Ansell fully disclaims any liability including any warranties related to any statement contained herein. According to current OSHA regulations, the employer has the final responsibility for selecting gloves and other personal protective equipment.

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Attachment B - EN 388 and ASTM F1790 test methods

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The CEN method is not well-suited for highly cut-resistant fabrics, especially those that contain glass or wire reinforcement. On those fabrics, the blade is rapidly worn dull during the testing and the data tends to over-estimate the cut resistance. The measured cut indices are very hard to reproduce, and the resulting data is not very meaningful.

In the US an entirely different method was developed by ASTM, method F1790, and it has been adopted by ISO as an international standard. To run this method, mount a specimen of glove material on a cylindrical support. Move a standard blade across this material at a standardized speed until it cuts through, as measured by electrical contact with the support. Use each blade only once and then discard it, so blade dulling cannot affect results. Make at least fifteen cuts on each glove material specimen, with different amounts of load used to press the blade onto the specimen. Then plot your data as load on the blade versus blade movement until failure. Report the cut resistance as the load on the blade that is required to produce a cut through in 20 mm of blade travel as determined by a regression procedure. This value is called the rating force, and it is commonly reported in grams force.

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