



PPE Hand Protection & Glove
Standards

George Stallings
Sales Solutions Inc.

Why Protect our hands?

- Hands are Important and complex

Injuries are Frequent and costly

Most importantly; Human Costs

We all strive to protect!



Costs Due to Injury

Commercial Costs

Injuries cause high medical bills and lost time

A hand injury with stitches will cost \$22,000-\$30,000 in shut down time, clean up, medical costs and rehabilitation.

- 110,000 lost-time hand injuries occur each year.
- 30% were wearing inadequate gloves

✓ 70% were wearing no gloves at all !!!



Hand Injuries

The most common causes of hand injuries are:

- Carelessness
- Lack of awareness
- Boredom: becoming complacent

Disregard for safety procedures

- Distractions
- Taking gloves off
- Improper glove



Injury Statistics

(Bureau of Labor Statistics 2008)

- Nearly 205,000 injuries and illnesses to the wrists/hands/fingers involved days away from work in 2008– 27% of the total for that year.

Incidence rate/10,000 full-time workers:

All private industry = 29.6

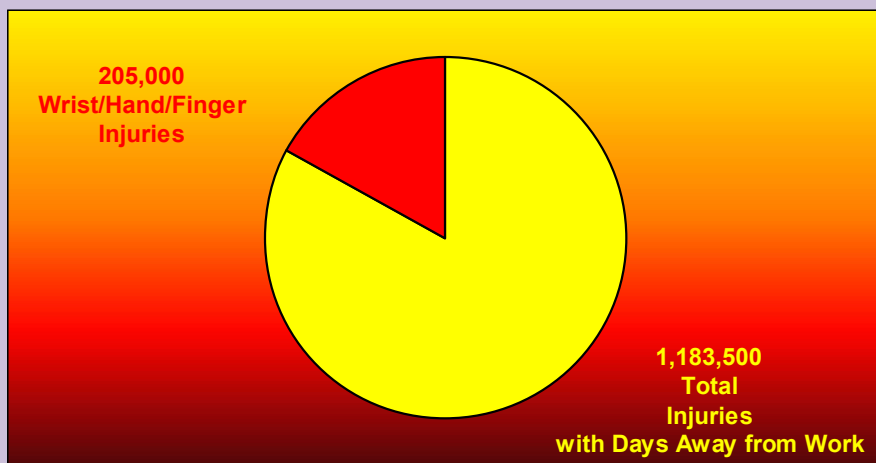
Manufacturing = 65.6

Construction = 71.4



Injury Statistics

(Bureau of Labor Statistics 2008)



Computing Cost (hand-out)

- **MODEL WORKSHEET**
- **Calculate the Impact of Accidents on Profits & Sales**
- Use this worksheet to determine the total costs of injuries and illnesses and their financial impact on your company's business operations.
- **DIRECT COST**
- To calculate direct cost of accidents/injuries, enter the following information:
- * Total value of insurance claim for injury/illness \$ _____
- (consists of medical costs and indemnity payments)
- **INDIRECT COST**
- To calculate direct costs of injury/illness, multiply the direct cost by a cost multiplier. The cost multiplier you use will depend on amount of direct costs
- If Direct Cost Is Use This Multiplier \$0 - \$2,999 4.5, \$3,000 - \$4,999 1.6, \$5,000 - \$9,999 1.2, \$10,000 or more 1.1. * Direct Cost X Cost Multiplier = Indirect Cost \$ _____ \$ _____ \$ _____
- **TOTAL COST**
- * Direct Cost + Indirect Cost = Total \$ _____ \$ _____ \$ _____
- **IMPACT ON PROFITABILITY**
- To calculate an injury/illness's impact on profitability, use your company's profit margin to determine sales your company would have to generate to pay for the injury/illness.
- Divide total profits by total sales to get your profit margin
- $\frac{\text{Total profits}}{\text{Total sales}} = \text{Profit Margin } \$ \text{_____}$
- \$ = _____ Divide total cost of injury/illness by profit margin to calculate how many sales your company must generate to pay for injury/illness. Keep the profit margin in decimal form.
- $\frac{\text{Total Cost of Injury or Illness}}{\text{Profit Margin}} = \text{Sales to Generate to Pay for Injury/Illness}$



Why Wear Cut Resistant Gloves?

Decreases # of hand injuries which saves \$ in claims against companies and lost time due to injury.

Cut protective gloves work when workers comply with safety requirements and wear the product.

- **Comfort** plays an important part in compliance and hence in cut protection – if the glove is not comfortable then it won't get worn.



Opposition to wearing a new product?

- Sometimes they say: “I’ve always worn leather” (or other types of gloves)

How do we work with this type of employee?



How do we change this mentality?

Offer high-dexterity gloves with specific features built in!

High-dexterity will keep gloves on workers hands as much as possible.

Issue gloves with a policy of returning used gloves in return for new. Accountability is now established.



What does OSHA require? Hand Protection

Addressed in OSHA Regulation
29 CFR 1910.138 – Hand protection



29 CFR 1910.138

General Requirement

- States that employers shall select and require employees to use appropriate hand protection when employees' hands are exposed to hazards such as:
 - Skin absorption of harmful substances
 - Severe cuts or lacerations
 - Severe abrasions
 - Punctures
 - Chemical burns
 - Thermal burns
 - Harmful temperature extremes



OHSA Selection

- **1910.138(b)**
- Selection. Employers shall base the selection of the appropriate hand protection on an evaluation of the performance characteristics of the hand protection relative to the task(s) to be performed, conditions present, duration of use, and the hazards and potential hazards identified.



Other OSHA Regulations Related to Hand Safety

- Hand and Portable Powered Tools and Equipment (29 CFR 1910.242)



- Control of Hazardous Energy – Lockout/ Tag out (29 CFR 1910.147)



- Machinery and Machine Guarding (29 CFR 1910 Subpart O)



The Complexity of Cut Resistance!

Different test standards EN and ANSI

Both use 1-5 rating for gloves ability to resist abrasion and cut but the levels have different values . EN level 3 is not ANSI 3 !

Different test machines and methods.

The Complexity of Cut Resistance!

Referred to in the marketplace as
intermingled. (Confusing)

Little, if any, correlation between test results (levels).

Why? There is familiarity, & investment (\$) of old standards by many companies.

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EN 388 protection against mechanical risks

Standards for gloves: Standard EN 388: 2003
Gloves Giving Protection from Mechanical Risks

Scope

This standard applies to all kinds of protective gloves in respect of physical and mechanical aggressions caused by abrasion, blade cut, puncture and tearing.

Definitions and Requirements

Protection against mechanical hazards is expressed by a pictogram followed by four numbers (performance levels), each representing test performance against a specific hazard.

The 'Mechanical Risks' pictogram is accompanied by a 4-digit code:



a. Resistance to abrasion: based on the number of cycles required to abrade through the sample glove.

b. Blade cut resistance: based on the number of cycles required to cut through the sample at a constant speed.

c. Tear resistance: based on the amount of force required to tear the sample.

d. Puncture resistance: based on the amount of force required to pierce the sample with a standard sized point.

A C T P- Abrasion, Cut, Tear, Puncture

The Complexity of Cut Resistance!

- **Watch for certain glove companies to display both EN and ANSI Standard indicators on the back of their gloves in the near future.**



XXXX

Abrasion
Cut Resistance
Tear Resistance
Puncture Resistance

ANSI

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Focus Standards

- **EN388- Testing and ratings of Mechanical risks- Older European standard well established in the Market.**

**ANSI/ISEA 105- 2005 – newer,
More Relevant**

**EN 420 General Glove
Performance (less relevant)**



EN 388 – Protective Glove Standards for Mechanical Risk

Test Property	Performance Level				
	1	2	3	4	5
Abrasion Resistance (cycles)	100	500	2000	8000	-
Blade Cut Resistance - Cut Index	1.2	2.5	5.0	10.0	20.0
Tear Resistance - Newtons	10	25	50	70	-
Puncture Resistance - Newtons	20	60	100	150	-



XXXX

Abrasion
Cut Resistance
Tear Resistance
Puncture Resistance



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EN 388 Cut Test

- Used in Europe, created in 1994 and revised in 2003

Uses only the Coup Test method.

Based on a circular blade which moves back and forth across the sample under a fixed load of 500 grams.

Test Property	Performance Level				
Blade Cut Resistance Cut Index	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
	1.2	2.5	5	10	20

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EN 388 Cut Test

Uses a comparison to the cut results of a cotton canvas.

A cut level of 5 means that it is 5 times more cut resistant than the reference cotton.

Not suitable for high cut-resistant gloves.

Example; those gloves containing fiberglass, steel. Here ISO13997-1999 is recommended to be used.

Test Property	Performance Level				
Blade Cut Resistance	1	2	3	4	5
Cut Index	1.2	2.5	5	10	20

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ANSI/ISEA 105-2005

- American National Standard for Hand Protection
- Defines the level for mechanical, thermal, chemical and dexterity performance of hand and arm PPE.
- Can be used for cut in the level or absolute value of grams
- Performance levels are based on ASTM F1790-97 methods



ASTM F1790-97

- American Standard Test Methods (ASTM)

**CPP test also known as CPPT – Cut
Protection Performance Test .**

This test measures the pressure (measures in grams) it takes to cut through 25mm (.98 inch) of material.

Must cut through mounting tape.

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ASTM F1790-05 updated test

- American Standard Test Methods (ASTM)

Standard testing method for cut uses the
TDM 100 or CPP Tester

This test measures the pressure (measures in grams) it takes to cut through 20mm (.79 inch) of material w/ the material held in place

A copper wire is used to determine breakthrough when touched

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Test Machines

- **CPP Tester: Cut Protection Performance Tester used in ASTM F1790 both 1997 and 2005. Used in ANSI /ISEA 105**



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ANSI/ISEA 105 Performance Levels

Performance Level	Weight in grams needed to cut through 1 inch of blade travel
0	< 199g
1	200 - 499g
2	500 - 999g
3	1,000 - 1,499g
4	1,500 - 3,499g
5	> 3,500g



ASTM D3389 Taber Abrasion wheel



ASTM D3389 Taber Abrasion wheel

- For ANSI there are levels 1-6 top is 20,000 cycles. 500 Grams applied for first 3 levels 1000 grams for levels 4-6.

ANSI- Woven or Knit samples are considered worn when first thread breaks, leather or solid materials must be worn through!!



ASTM D3389 Taber Abrasion wheel

- This allows higher results for leather.

Harder to achieve high levels on ANSI vs. EN

For EN there are levels 1-4. 8000 cycles is level 4.



ANSI/ISEA 105 Abrasion Performance Levels

Performance Level	Number of cycles to break through. 0-3 is 500G, 4-6 is 1000G applied to wheel.
0	< 100g
1	>100g
2	>500
3	>1,000 g
4	>3000
5	>10,000
6	>20,000



How does Leather and cotton stack up?

- Split leather Safety cuff 266 grams to cut.
 - Abrasion cycles as high 4100
- Grain Cow hide driver 183 grams to cut.
 - Abrasion cycles
- Grain Pig hide driver 170 grams to cut.
 - Abrasion cycles.



Taeki 5 Nitrile coating

- Cut level 5 on EN 388
- Cut level 3 on ANSI 105 tested using ASTM 1790-05
- Grams to cut 1205
- Abrasion level 4? EN 388
- Abrasion cycles

Lets compare



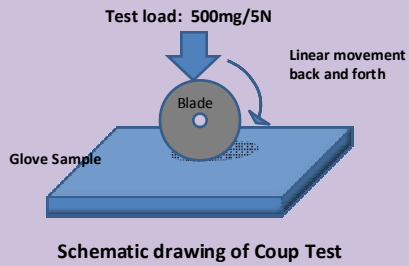
Split Leather

- Cut level 1 on ANSI
- Grams to cu 266
- Abrasion level EN
- Abrasion cycles



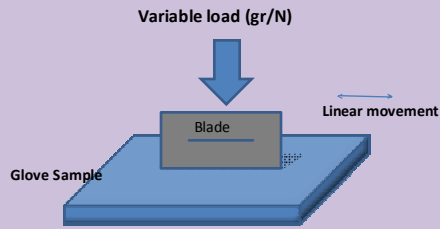
Know the Difference

Used in EN388 Testing



Schematic drawing of Coup Test

Used in ASTM F1790 Testing



Schematic drawing of CPP and TDM Test

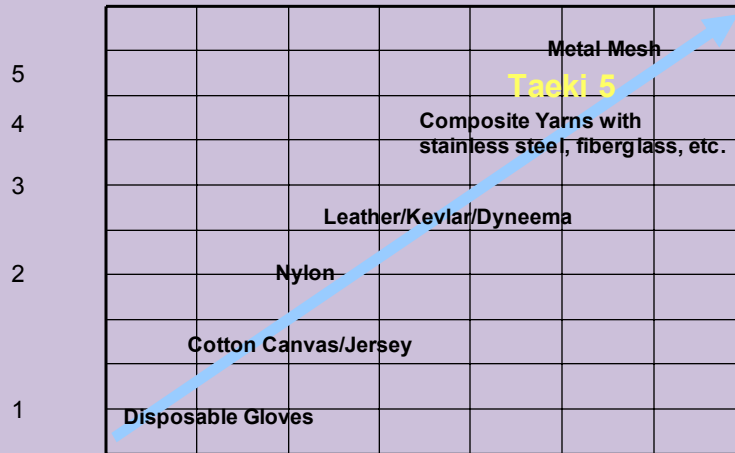


Know the Difference cut testing

	EN 388	ASTM F1970-97	ASTM F1970-05
Machine type	Coup Test Tester	CPP Tester	TDM /CPP Tester
		Mounting tape	Copper wire
What it measures	Measures number of times it takes to cut fabric vs. cotton canvas	Measures the amount of gram weight it takes to cut through fabrics	Measures the amount of weight it takes to cut through fabrics
Reports measurements in	Levels and index	Levels and gram weight	Levels and gram
Test length	Back and Forth until cut through	25mm Linear (@ inch)	20mm Linear (@ ¾ inch)
Weight used	500 grams constant	Increasing gram weight	Increasing gram weight
Other info	Should not be used on high cut because blade dulls between test	Higher ratings than 05	Lower ratings than 97
Are test comparable?	No comparison to any other method	No comparison to any other method	Comparable to ISO13997



Cut Resistance Relative Ranking



Cut Resistance is a function of a glove's material composition and thickness.
These are typical qualities/materials for each CPPT Levels

Know the difference cut testing

It is important to understand that:

- EN388 cut level X (Couptest) does NOT necessarily correspond to the same ANSI/ISEA105 level X (ASTMF1790'97).
- CPP/TDM indicates how much force/load is need to slash/cut through a fabric.
- Couptest indicates how many repetitive cuts on the same position are needed to cut through.
- CPP values measured with ASTMF1790 '97 give higher results than the 'ASTMF1790'05 and TDM test on the same glove, and this is purely due to an improvement of the standard.



What we need to ask?

What standard? EN 388 or ANSI 105-2005

If ANSI, What test method was used, 97 or 05

What was the Actual Gram results?

Was the actual gauge, weight, weave, coating all same as what is used in glove construction?

What level are you claiming?



Standards EN 420

EN 420 General Requirements of glove

- PH level, 3.5-9.5
 - Chromium level less than 10ppm
 - Rubber must meet EN 455-3 for proteins
 - Cleaning instruction- must not degrade performance
 - Electrostatic properties
 - Dexterity- smallest size pin that can be picked up 3 times in 30 seconds
 - Sizing- consistence
 - Water Vapor transfer-breath ability
- Based on Category
 - Category 1: Minimum risks
 - Category 2: Protection required
 - Category 3: Protection against irreversible injuries and mortal danger
 - Markings of Gloves Category 1 & 2 include: CE sign, item no. size, article, address of manufacturer, pictograms with levels



Types of Cut Resistant Yarns

- Aramid
 - Kevlar
 - Twaron (generic name for Kevlar)
- HPPE (Dyneema, Spectra)
- Engineered Yarns (**Taeki 5**) (2 or more yarns combined.)



QS is proud to introduce the TAEKI 5 series of High Cut Resistant Hand Protection. In developing TAEKI 5 technology, QS addresses the safety needs of the industry by delivering EN420 Cut Level 5 protection, lightweight seamless shells and several coating options for varying degrees of abrasion resistance and tactile sensitivity. Our various slipping polymers including our HCT two step, proprietary nitrile, rubber and PU palm coatings give secure grip and in various applications including dry and wet/sloppy grip.



TAEKI 5

QS

QS Quality Solutions for All Your Hand Protection Needs
 Room 1001, Shanghai International Trade Centre, 2201
 Sun An Road, Shanghai 200120, CHINA
 Tel: 86-21-63799599 Fax: 86-21-63799598
 Http://www.qsglove.com E-mail: sales@qsglove.com

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Exclusively Distributed by:
 Global Color and Safety, Inc.
 12200 North York Road
 Dayton, OH 45424
 Tel: 761.476.2129 Fax: 761.476.2148
 www.globalcolor.com

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 100 GARDNER PARKWAY, SUITE 300, WILMINGTON, OH 45390
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What is Taeki 5?

- A new filament fiber resulting in exceptionally **high cut resistance** without sacrificing **dexterity** and tactile sensitivity.
- Filament yarns provide increased durability
- Super light weight
- Used in the automotive, metal production, glass, fabrication, etc.
- EN 388 Cut level 5f



Taeki 5

- High Abrasion Resistance
- Hi Cut Resistance
- High Heat Resistance
- 212 to 662 Degree Fahrenheit
- High Comfort and fit
- Lint free and UV Resistant
- Some types can be worn alone or as a liner under other gloves



Kevlar / Twaron

• Characteristics:

- ✓ 5x stronger than steel on an equal weight basis
- ✓ Great tensile strength; high modulus (resistance to extension)
- ✓ High resistance to cuts and abrasion
- ✓ Thermal stability – high heat resistance (320°F with little degradation after extended exposure)
- ✓ Resistant to many chemicals and solvents
- ✓ Non-conductive
- ✓ No melting point; low flammability
- ✓ Sensitive to ultraviolet radiation
- ✓ Can be laundered or dry cleaned without affecting cut resistance

• Applications:

Automotive, light heat applications, glass operations, metal stamping, material handling, fishing industry, general maintenance, woodworking, waste handling and recycling

Kevlar® is a registered trademark of E.I. du Pont de Nemours and Company
Twaron® is a registered trademark and the property of Teijin Aramid and Teijin Limited



Dyneema & Spectra

• **Characteristics:**

✓ Also called HPPE or UHMWPE

- ✓ 15x stronger than steel by weight
- ✓ 40% stronger than Aramid fibers
- ✓ Produced with a gel-spinning process to make gloves soft
- ✓ Cool to wear, not scratchy, lightweight
- ✓ Good abrasion resistance
- ✓ Great dexterity; minimal flex fatigue
- ✓ Chemical resistant
- ✓ UV resistant
- ✓ Not recommended for high heat applications - melts at 270°F
- ✓ Can be bleached; laundered repeatedly; increases longevity

• **Applications:**

Electronics, glass cutting, metal handling, food processing and meat processing, general duty, parts assembly and construction

Dyneema™ is a trademark of Dyneema DSM.
Spectra® is a registered trademark of Honeywell International Inc.



It's all in the thread!

	Filament type	Abrasion	Cut	Heat	Wash ability	Lint Free	Cost	Silicone Free	Available colors
Dyneema	Continuous	4	3 or 5	176 F	Yes will lose properties if wash over 90C	Yes	High	Yes	white/gray
Kevlar/Aramid	Spun yarn short fibers	1 to 3	3	800 F	Yes, no change to properties but will fray	No	Med		yellow
Taeki 5	Continuous	4	5	482 F	Yes	Yes	Med	Yes	Yellow black white gray

Other Cut Materials

• **Steel Core Wrapped:**

- ✓ Cut and abrasion resistant
- ✓ Usually wrapped with other fibers such as Dyneema, Polyester, or Nylon
- ✓ Can be laundered in caustic detergents and bleached

• **Fiber-Metal Blends:**

- ✓ Durable; abrasion resistant
- ✓ Blended with Spectra, Kevlar and Stainless Steel

• **Metal Mesh:**

- ✓ Interlocked stainless steel mesh
- ✓ Offers superior cut and puncture protection

Applications:

Meat & poultry processing, glass handling, metal fabrication, automotive manufacturing and pulp and paper industry



Other Cut Materials

• **Glass Fibers:**

- ✓ Engineered yarn made by wrapping highly flexible, cut resistant glass fiber with soft nylon fiber
- ✓ Relatively inexpensive compared to other engineered yarns
- ✓ Highly cut resistant



Other Cut Materials

Glass fibers:

Applications:

Metal fabrication, textile industry,
meat & poultry industries,
automotive sub assembly



ANSI Level 4 Materials

- Heavyweight Kevlar
- Kevlar Armor
- Dyneema
- "High Tech" Fibers
- Engineered Yarns
- Nuaramid/Polyester/Steel
- Nuaramid/Polyester
- Stainless Steel/Polyester Wrap
- Kevlar/Stainless Steel
- Spectra



ANSI 4 Cut Resistant Glove – 40HP

- 13 gauge high performance polyethylene/polyester liner plated with Spandex® and Coolmax®
- Coolmax® is a fabric that wicks away moisture, is breathable and enhances drying and keeps hands cool and dry
- Lightweight, cut resistant glove – meets ANSI 4 (1656g)
- Lint-free, UV resistant and machine washable
- Thermal lining provides additional warmth and comfort
- Offers tactile sensitivity and dexterity for safety during use
- Meets 21CFR, parts 170-199 for use in foodservice environments
- Can be used across many industries including food processing, glass handling, metal fabrication, meat processing, packaging, shipping and receiving, utilities, manufacturing and steel applications



Used as insert!!



ANSI Level 5 Materials

- **Stainless Steel with Synthetic Fiber**
- **Stainless Steel with Dyneema/Polyester**
- **Stainless Steel Core & Polyester**
- **“High Tech” Fibers/Engineered Fibers**
- **3 Strands Stainless Steel**
- **Spectra & Stainless Steel**
- **Kevlar Armor**
- **Heavyweight Kevlar**



Characteristics that Affect Cut

Basis Weight (oz./yd²)

- Fabric weight per unit area. The higher the basis weight, the higher the cut resistance because there is more material present.

Fabric Construction

Includes types of knit or weave, threads/stitches per inch. This can affect cut resistance.



Characteristics that Affect Cut

•Coatings

- Some coatings are more cut resistant than others and thicker coatings provide more material to resist cut-through. Some coatings actually decrease cut resistance (usually thin coatings).

No single parameter protects the glove user.



Coatings

- Latex- thicker than others so provides separation from hazard. Good Grip, decent abrasion.
- Nitrile- Thinner improves dexterity, good chemical resistance. Good Abrasion, good cut
- Polyurethane – Thinnest for excellent dexterity. Very good abrasion, can effect cut.



Tips for maintaining the glove program

Have your supplier do a glove survey annually.

How much of your total PPE cost is in glove usage?

Make sure of adequate glove protection.
However, **DON'T OVERPROTECT! (DO FORLIFT DRIVERS NEED A CUT LEVEL 5 PRODUCT?)**

New ANSI Level 5 Glove



- ANSI Level 5
- 7g Spectra/Fiberglass/Polyester
- Available in sizes XS –XL
- Ideal for food service or food processing and other tasks that require high level of cut resistance

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New ANSI Level 4 Glove



- ANSI Level 4
- 13g Kevlar/Steel Shell
- Foam Nitrile Palm Coating
- Great Dexterity and Grip
- Available in sizes S –XL
- Ideal for many industries including glass handling, metal fabrication, packaging, shipping and receiving, utilities, manufacturing and steel applications
-

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New ANSI Level 4 Glove



- ANSI Level 4
- 10g Aramid/Polyamide Shell
- Foam Nitrile Palm Coating
- Great Dexterity and Grip
- Available in sizes XS – XXL
- Ideal for many industries including glass handling, metal fabrication, packaging, shipping and receiving, utilities, manufacturing and steel applications

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Twaron

- Twaron is the brand name of [Teijin Aramid](#) for a [para-aramid](#). It is a heat-resistant and strong [synthetic fiber](#) developed in the early 1970s by the Dutch company [AKZO](#), division, later Akzo Industrial Fibers. The research name of the [para-aramid fiber](#) was originally Fiber X, but it was soon called Arenka. Although the Dutch para-aramid fiber was developed only a little later than DuPont's [Kevlar](#), introduction of Twaron as a commercial product came much later than Kevlar due to financial problems at the AKZO company in the 1970s.



In summary..

- Glove surveys
- Have users Test the glove before purchase.
- Use all data to determine the best product for your application.

Thank you !!

