Personal Safety in Welding and Cutting

There are several sources of personal safety standards and guidelines to follow when welding and cutting. Wherever possible, follow all the appropriate standards including: ANSI, AWS, OSHA, NEMA, and others. Become trained on the equipment you will be using, and read the owner's manual before using any piece of welding or cutting equipment.

Protective booths or screens should be set up and workers should wear the proper protective clothing, including respiratory protection and ear plugs, especially if they are working out-of-position. The ANSI Z49.1-2012 Standard provides detailed information and guidance regarding ensuring the safety of personnel and property during welding processes.

To obtain a copy of the ANSI Z49.1-2012 Standard, visit: https://pubs.aws.org/content/free_downloads/AWS_Z49.1_SAFETY_IN_WELDING_AND_CUTTING_AND_ALLIED_PROCESSES.pdf.

Head Protection

ANSI/ISEA Z89.1-2014

This standard provides performance and testing requirements for industrial helmets, commonly known as hard hats. It establishes the Types and Classes of protective helmets, depending on the type of hazard encountered.

Helmet Types – Impact Protection

- **Type I** helmets protect the wearer from top impact
- **Type II** helmets protect the wearer from top and lateral impact

Helmet Classes — Electrical Performance

Three classes are also included in the ANSI/ISEA Z89.1-2014 standard that indicate the helmet's electrical insulation rating:

- **CLASS E** (Electrical) helmets intended to reduce the danger of exposure to high-voltage electrical conductors, proof-tested at 20,000 volts.
- **CLASS G** (General) helmets intended to reduce the danger of exposure to low-voltage electrical conductors, proof-tested at 2,200 volts.
- **CLASS C** (Conductive) helmets not intended to provide protection from electrical conductors.

The test requirements for ANSI/ISEA Z89.1-2014 are available from the Industrial Safety Equipment Association (safetyequipment.org).

Non-Mandatory ANSI/ISEA Z89.1-2014 Tests

Reverse Donning

In order for a helmet to be worn in reverse or a swing ratchet suspension to be used in a helmet, that particular helmet must be marked for reverse donning which indicates that it meets the non-mandatory reverse donning test. In order to do this, the helmet's suspension must be reversed so that the nape strap is in the rear (back of wearer's head).

Lower Temperature (LT)

The traditional low temperature test for a helmet is -18°C or 0°F. Helmets that meet the ANSI/ISEA Z89.1 requirements for LOWER temperatures (-30°C or -22°F) can be marked with LT by the manufacturer.

High Visibility (HV)

Helmets that meet the non-mandatory requirements for high visibility, including special tests for Chromaticity and Luminescence for added visibility, can be marked with HV by the manufacturer.

Eye Protection

Use a welding helmet with the proper shade lens to protect against flash burn. Use shaded welding curtains to protect others in the welding area. Safety glasses protect against damage from foreign objects — they should be worn at all times, even under the welding helmet.

ANSI Z87.1-2020

Establishes the criteria for using, testing, markings, choosing, and maintaining eye protection to prevent or minimize injuries from eye hazards. The updates in the revision reflect recognition of innovative product designs and performance capabilities that had not been previously addressed but which can provide appropriate protection against workplace eye and face hazards. These are seen by changes in transmittance allowances to recognize the unique properties of wrap lenses and expanded welding filter shades. The 2020 edition now includes testing, performance and marking for anti-fog lenses and includes relaxed optics criteria (as an option) in response to end-user needs.

Hearing Protection

Occupational hearing loss is one of the most common work-related illnesses in the United States. Each year, about 22 million U.S. workers are exposed to hazardous noise levels at work. In addition, over 30 million U.S. workers are exposed to chemicals, some of which are harmful to the ear (ototoxic) and hazardous to hearing.
Source: National Institute for Occupational Safety and Health (NIOSH)

NOISE REDUCTION RATINGS

Noise Reduction Rating (NRR) is a unit of measurement used to determine the effectiveness of hearing protection devices to decrease sound exposure within a given working environment. Classified by their potential to reduce noise in decibels (dB), the unit of measure for the power or density of sound, hearing protectors must be tested and approved by the American National Standards Institute (ANSI) in accordance with the Occupational Safety & Health Administration (OSHA). The higher the NRR number associated with a hearing protector, the greater the potential for noise reduction.

PASSIVE HEARING PROTECTOR OPTIONS AND STYLES

- Disposable foam plugs are compressed or shaped prior to insertion, with varying sizes and shapes to accommodate the work force. The most popular variety is made of expandable, slow-recovery foam.
- Pre-molded, reusable plugs are made from flexible materials that are preformed to fit the ear. They are generally available with a joining cord.
- Banded earplugs, also called canal caps, consist of pods or flexible tips on a lightweight headband. Since they are easy to put on, they are ideal for use in and out of noisy environments.
- Earmuffs have rigid cups with soft plastic cushions that seal around the ears to block noise. For very loud noises, wear muffs and plugs together for approximately 5 dB of additional protection.
- Electronic earmuffs incorporate music listening, amplification and high-level noise suppression. These also provide easier communication in impulse noise environments. They generally require batteries.

CREATE A SUCCESSFUL HEARING CONSERVATION PROGRAM THROUGH BEST PRACTICES

In the United States, OSHA's Occupational Noise Standard 29 CFR 1910.95 requires that employers implement a Hearing Conservation Program if they have work areas with noise levels at or above 85 dBA (as an 8-hour Time Weighted Average).

Required by OSAH when employees are exposed to 85 dBA or higher (8-hour TWA)			Tools to Assist
Noise Monitoring	Noise monitoring is required within the facility.	• **Area Noise Sampling:** Using a sound level meter, take a general measurement of noise in each section of your facility • **Personal Noise Sampling:** Using a dosimeter, measure each employee's exposure to noise over his/her work shift	• Sound level meters • Dosimeters • In-ear dosimeters
Audiometry	Annual hearing tests must be available to all employees, and performed by a professional or qualified technician.	• **Baseline Audiogram:** Required within six months of first exposure or hire • **Standard Threshold Shift (STS):** Employees who experience a 10 dB or more shift at 2000, 3000 and 4000 Hz in either ear compared to baseline must be notified in writing within 21 days. If the loss is determined to be occupational, the employer must evaluate the employee's current hearing protectors and re-train the employee on use and fit	• Audiometers • Sound booths
Hearing Protectors	A variety of suitable hearing protectors must be made available to employees at no cost.	• **Action Level 85 dBA:** Hearing protectors must be made available at no cost to your employees for those exposed to an 8-hour TWA of 85 dBA. Those with established Standard Threshold Shifts (STS) are required to wear Hearing Protection Devices (HPDs), as are new employees who have not taken their baseline audiogram	• Earplugs • Earmuffs
Training	Provide annual hearing conservation training to all employees.	• Effects of noise exposure • Use, selection and fitting of hearing protection devices • Audiometric test procedures	• Fit testing devices • Fitting posters for earplugs and earmuffs
Record Keeping	Retain all employee records, including exposure measurements and audiometric tests.	• **Records to Keep Accessible to Employees:** Exposure measurements, audiometric tests and OSHA Form 300	• OSHA posters

Respiratory Protection

OSHA STANDARD 29 CFR 1910.134

This is the general industry standard to protect the health of employees from harmful dusts, fogs, fumes, mists, gases, smokes, sprays or vapors. It applies to all occupational airborne exposures to contaminated air when the employee is exposed to a hazardous level of an airborne contaminant, is required by the employer to wear a respirator or is permitted to wear a respirator.

RESPIRATORY HAZARDS

- **Dusts:** Often created by sanding, grinding, cutting and sweeping of various materials.
- **Fumes:** Generally created when metal is heated to the boiling point and quickly cooled, such as during welding.
- **Mists:** Tiny droplets formed from the spraying of liquid materials. Mists are typically created by spraying, plating and mixing operations.
- **Gases:** Substances that are airborne at room temperature and are often invisible, including carbon monoxide, methane and freon. Gases are similar to ambient air in their ability to diffuse or spread freely throughout a container or area.
- **Vapors:** The gaseous state of substances that are either a liquid or solid at room temperature. They are formed when solids or liquids evaporate, such as solvents, paint thinner and gasoline.
- **IDLH:** Immediately Dangerous to Life or Health (IDLH) environments require very specific respiratory protection. You should never use air-purifying respirators in these applications. IDLH environments include: contaminant concentrations at or above IDLH limits, contaminant concentrations at or above 10% of the LEL and/or less than 19.5% oxygen.

GUIDANCE FOR ESTABLISHING A RESPIRATORY PROTECTION PROGRAM — 6 SIMPLE STEPS

The following information is intended to highlight the major steps involved in setting up a respiratory protection program and to identify additional resources. Employers who decide to use respiratory protection to help lower worker exposures to hazardous airborne contaminants must follow all requirements of the Occupational Safety and Health Administration's (OSHA) Respiratory Protection Standard 29 CFR 1910.134.

Step 1 | Exposure Assessment

OSHA's Respiratory Protection Standard 1910.134(d) states: the employer shall identify and evaluate the respiratory hazard(s) and an identification of the contaminant's chemical state and physical form. The American Industrial Hygiene Association (AIHA) maintains a list of industrial hygienists who contract to do air monitoring (aiha.org). In addition, OSHA offers a free consultation program.

Step 2 | Written Respiratory Program

A written program is required for mandatory use of respiratory protection
and recommended for voluntary use. OSHA 1910.134(c) states: "In any workplace where respirators are necessary to protect the health of the employee or whenever respirators are required by the employer, the employer shall establish and implement a written respiratory protection program with work site-specific procedures."

Step 3 | Respirator Selection

OSHA requires the employer to evaluate respiratory hazard(s) in the workplace (contaminant and concentration), identify relevant workplace and user factors, and base respirator selection on these factors. The respiratory hazard evaluation includes “a reasonable estimate of employee exposures” to respiratory hazard(s). The respirator type or class is then selected by comparing the employee’s exposure to the occupational exposure limit and determining the minimum necessary respirator assigned protection factor. Where the employer cannot identify or reasonably estimate the employee exposure, OSHA requires the employer to consider the atmosphere as IDLH.

Step 4 | Medical Evaluation

Medical evaluation of the employee is required for mandatory use of all respirators or voluntary use of elastomeric face pieces, and recommended for voluntary use of filtering face piece respirators.

Step 5 | Fit Testing

Fit testing is required for mandatory use of all tight-fitting face pieces and recommended for voluntary use. OSHA 1910.134(f) states: “The employer shall ensure that an employee using a tight-fitting face piece respirator is fit tested prior to initial use of respirator, whenever a different respirator face piece (size, style, model or make) is used, and at least annually thereafter.”

Step 6 | Respirator Training

Training is required for mandatory use and recommended for voluntary use of respirators. OSHA 1910.134(k) states: “This paragraph requires the employer to provide effective training to employees who are required to use respirators. The training must be comprehensive, understandable, and recur annually and more often if necessary.

WELDING FUMES AND GASES

Welding and cutting processes generate fumes that can be hazardous if inhaled. Welding fumes can contain:

- Vaporized metal from the base metal itself, from welding rods, wires, coatings and fluxes.
- Rust, mill scale and coatings that may be on the surface of the metal.
- By-product gases such as ozone, carbon monoxide and nitrogen dioxide.

It is important that workers be protected from over-exposure to these fumes and gases.

National Institute for Occupational Safety and Health (NIOSH) studies suggest that welders have an increased risk of respiratory illness, including bronchitis, airway irritation, lung function changes and lung cancer[1].

1. Health Effects of Welding, Antonini Health Effects Laboratory Division, NIOSH,Critical Reviews in Toxicology, 2003.

Help protect yourself with safety equipment designed specifically for the professional welder. Welders must have proper ventilation and an approved respirator to protect them from hazardous fumes and gases. Respirators should be comfortable and not hamper the use of other face-shielding equipment.

There are situations when standard air-purifying respirators alone will not guarantee an adequate supply of breathable air. Welding operations in areas with poor ventilation and air quality increase the risk of inhaling toxic fumes. Therefore, it may be necessary to provide additional ventilation or an air-supplied respirator. Exhaust hoods or fume extractors, combined with the use of exhaust fans, are common means of removing fumes.

OSHA's Hexavalent Chromium Standard

Hexavalent chromium Cr(VI) may be present in fumes that are created in the welding and cutting processes of stainless steel, non-ferrous chromium alloys and chrome plated metals. The Occupational Safety and Health Administration's (OSHA) Hexavalent Chromium Cr(VI) Standard sets the permissible exposure limit for Cr(VI) as 5µg/m3 (micrograms per cubic meter) as an eight-hour time-weighted average (TWA).

Use respiratory protection when needed. Refer to the filler metal SDS for information about respiratory and contact dangers of hexavalent chromium.

Manganese

Welding fumes are composed of metals and most fumes contain a small percentage of manganese. There is a concern by workers, employers, and health professionals about potential neurological effects associated with exposure to manganese in welding fumes. NIOSH conducts research and reviews the published scientific literature to assess this problem.

Manganese is an essential nutrient. A healthy person with normal liver and kidney function can excrete excess dietary manganese. Inhaled manganese is of greater concern because it bypasses the body's normal defense mechanisms. This can lead to manganese accumulation and adverse health effects including damage to the lungs, liver, kidney and central nervous system. Male workers exposed to manganese also have a higher risk of fertility problems. Prolonged exposure to high manganese concentrations (>1 mg/m3) in air may lead to a Parkinsonian syndrome known as "manganism." Recent studies indicate neurological and neurobehavioral deficits may occur when workers are exposed to low levels of manganese (<0.2 mg/m3) in welding fumes. These effects include changes in mood and short-term memory, altered reaction time, and reduced hand-eye coordination.

NIOSH Publication No. 88-110: Criteria for a Recommended Standard: Welding, Brazing, and Thermal Cutting presents the criteria and standards for preventing occupational diseases arising from exposure to welding, brazing, and thermal cutting. See 29 CFR 1910.1000, Toxic and Hazardous Substances for General Industry.
Source: the National Institute for Occupational Safety and Health (NIOSH)

Silica

OSHA's Respirable Crystalline Silica standard for general industry and maritime requires employers to limit worker exposures to respirable crystalline silica and to take other steps to protect workers.

Among other things, the standard requires employers to:

- Assess employee exposures to silica if it may be at or above an action level of 25 µg/m3 (micrograms of silica per cubic meter of air), averaged over 8-hours.
- Protect workers from respirable crystalline silica exposures above the permissible exposure limit (PEL) of 50 µg/m3, averaged over 8-hours.
- Limit workers' access to areas where they could be exposed above the PEL.
- Use dust controls to protect workers from silica exposures above the PEL.
- Provide respirators to workers when dust controls cannot limit exposures to the PEL.
- Use housekeeping methods that do not create airborne dust, if feasible.
- Establish and implement a written exposure control plan that identifies tasks that involve exposure and methods used to protect workers.
- Offer medical exams — including chest X-rays and lung function tests — every three years for workers exposed at or above the action level for 30 or more days per year.
- Train workers on work operations that result in silica exposure and ways to limit exposure.
- Keep records of exposure measurements, objective data, and medical exams.

For more information, please see the OSHA Standards, Interpretations, and Directives General Industry and Maritime Standard (29 CFR 1910.1053, Respirable Crystalline Silica).
Source: Occupational Safety and Health Administration (OSHA), OSHA.gov

Contaminant/Application	Potential Health Effects from Over Exposure[1,2]
Steel/Manganese Alloys	Pneumoconiosis, siderosis, central nervous system effects
Stainless Steel	Pneumoconiosis, kidney effects, lung irritation, cancer
Aluminum	Respiratory irritation (due to ozone)
Galvanized Steel	Metal fume fever
Cadmium	Metal fume fever, respiratory irritation, lung cancer, kidney effects
Lead	Central nervous system effects, systemic poisoning
Ozone	Respiratory irritation, lung congestion, bronchitis, headache, dry throat
Carbon Monoxide	Anoxia, central nervous system effects
Carbon Dioxide	Asphyxiation
Phosgene	Respiratory irritation, anoxia, pulmonary edema
Oxides of Nitrogen	Respiratory irritation and edema
Silica Dust	Silicosis, lung cancer, kidney disease, and airway diseases

1. Documentation of TLVS and BEIS, American Conference of Governmental Industrial Hygienists, 7th. edition, 2004.
2. Clayton, G.D., Clayton, F.E. Patty's Industrial Hygiene and Toxicology. Vol II New York John Wiley and Sons Inc., 1994

Hand Protection

OSHA 29 CFR 1910.138

(a) General requirements. Employers shall select and require employees to use appropriate hand protection when employees' hands are exposed to hazards such as those from skin absorption of harmful substances, severe cuts or lacerations, severe abrasions, punctures, chemical burns, thermal burns and harmful temperature extremes.
(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.

ANSI/ISEA 105-2016

ANSI/ISEA 105-2016 addresses the classification and testing of hand protection for specific performance properties related to chemical and industrial applications. This standard provides performance ranges related to mechanical protection (cut-resistance, puncture resistance and abrasion resistance), chemical protection (permeation resistance, degradation) and other performance characteristics such as ignition resistance and vibration reductions based on standardized test methods.

HOW TO CHOOSE THE PROPER GLOVE SIZE

Wearing properly sized gloves is as important as the glove you choose. First, measure the circumference of your hand as illustrated here, then compare it to the sizing chart.

Glove	XSmall	Small	Medium	Large	XLarge
Hand	6”-7”	7”-8”	8”-9”	9”-10”	10”-11”

GLOVE CARE AND MAINTENANCE

Proper care and cleaning of gloves on a regular basis is essential in maintaining quality hand protection for employees.

Cleaning and Washing: Most styles of gloves will perform better and last longer when they are cleaned regularly. Certain glove styles launder better than others.

Inspection: Daily inspections are recommended prior to wearing, to assure that no significant damage to either the inside or outside surface of the glove has occurred.

Storage: Gloves should be stored in well-ventilated bins or shelves at normal room temperature, free from direct sunlight.

CUFF MATERIALS

Leather: For longer wear and heavy-duty applications (launderable).

Denim: Economical single-fabric material (launderable).

Duck: Single ply of cotton material (launderable).

Plasticized: Waterproof polyethylene layer laminated between two pieces of fabric (launderable).

Rubberized: Two layers of fabric with a rubber material in between. Adds water resistance in addition to heavier wear resistance.

Starched: Two layers of fabric laminated, then starched (launderable).

GLOVE CONSTRUCTION

Gunn Cut

Features: Seamless on back. The palm side of the middle two fingers is a separate glove pattern and is sewn to the palm at the base of the middle two fingers. In full leather and leather palm styles, the seam is reinforced with a welt that gives additional resistance to wear in this critical area.

Benefits: Seam in natural hand crease allows flexibility; seamless back increases comfort. Finger seams away from the palm, increasing gloves’ durability and wear life.

Clute Cut

Features: Seamless palm made from a continuous piece of leather. Back of the glove has parallel seams. Finger side seams are toward the palm side of the glove.

Benefits: Seamless palm means greater ease of movement and comfortable gripping. Primarily used in fabric gloves and lightweight leathers.

Thumb Styles

- **Straight Thumb:** Designed for close-fisted work. The seams are out of the wear area during gripping activities.
- **Keystone Thumb:** Allows the greatest freedom of movement and is the most comfortable.
- **Wing Thumb:** Designed for open-handed work such as pushing, pulling and lifting.

CHEMICAL AND LIQUID-RESISTANT GLOVES

Where chemical hazards or immersion in liquids is a concern, chemical/liquid resistant gloves are available in various compounds, and in supported or unsupported styles to protect the hands. Several things to consider when selecting the gloves needed for each particular application include:

Supported vs. Unsupported

Base fabrics for **supported gloves** include jersey, which is soft and helps to absorb perspiration, or a thinner interlock fabric that helps give the glove added strength for resistance to cuts, snags, abrasions and punctures.

Unsupported gloves provide enhanced dexterity and are either lined or unlined. Unsupported lined gloves have a thin coating (commonly referred to as a flock lining) embedded on the interior of the glove to help absorb perspiration, add comfort and aid in donning and doffing.

Permeation and Degradation

Permeation and degradation are two ways of measuring the protective capabilities of a material. It's important to choose the right glove to protect against the specific chemicals present in each application.

Permeation is the process in which a chemical can pass through protective film without going through pinholes, pores or other visible openings. The chemical molecules move between the molecules of the material and make their way to the other side of the film. Breakthrough is calculated in minutes and represents the time it takes for the chemical to first be detected on the other side of the film. Rate is a measurement of the highest flow rate for the permeating chemical during the course of a six hour test.

Degradation is the reduction of one or more physical properties of a glove due to contact with a chemical. Certain glove materials may become hard, stiff or brittle, or they may become softer, weaker and swell to several times their original size. If significant degradation occurs, a glove's permeation resistance is quickly impaired, but degradation and permeation do not always correlate.

Chemical resistance testing that conforms to industry standards includes:

- **ASTM F739 Standard Test Method** for Permeation of Liquids and Gases through Protective Clothing Materials under Conditions of Continuous Contact
- **ASTM F1383 Standard Test Method** for Permeation of Liquids and Gases through Protective Clothing Materials under Conditions of Intermittent Contact
- **EN 374 European Standard Protective Gloves** Against Chemicals and Microorganisms

Glove Material Selection Guide for Chemical Resistance

Natural Rubber Latex (NRL) resists bases, acids, alcohols and diluted aqueous solutions of most types of chemicals. They also offer fair protection against undiluted ketones and aldehydes. In addition, natural rubber latex provides some resistance to cuts. There have been some reports of allergic reactions to the proteins in natural rubber. In cases of latex sensitivity, nitrile, neoprene and PVC are good alternatives.

Nitrile, a synthetic rubber compound, offers good protection against bases, oils, many solvents and esters, grease and animal fats. Nitrile gloves are not recommended for ketones and some organic solvents. They do provide, however, excellent resistance to snags, punctures, abrasions and cuts.

Neoprene (polychloroprene) is another synthetic rubber compound. Neoprene gloves protect against a very broad range of oils, acids, caustics and solvents. Neoprene offers less resistance to snags, punctures, abrasions and cuts than nitrile or natural rubber.

Polyvinyl Alcohol (PVA) is highly resistant to aliphatics, aromatics, chlorinated solvents, esters and most ketones. PVA gloves also resist snags, punctures, abrasions and cuts, but quickly break down when exposed to water and light alcohols.

Polyvinyl Chloride (PVC) gloves provide protection against many acids, caustics, bases and alcohols. PVC is not recommended for ketones or many other types of solvents. It generally offers good abrasion and cut resistance, but some glove styles are susceptible to cuts.

Polyethylene offers economical protection from mild chemicals, oils, fats, punctures and abrasions. Component materials of polyethylene gloves comply with FDA regulations for food contact.

Polyurethane (PUR) resists bases, acids, alcohols, grease and animal fats. They're not recommended for most types of organic solvents. Polyurethane provides excellent snag, puncture, abrasion and cut resistance. In the form of a foam, it can be highly effective as an insulating liner inside some types of supported gloves.

Butyl rubber offers superior resistance to highly corrosive acids, ketones and esters. It protects well against bases, alcohols, amines and amides, glycol ethers, nitro-compounds and aldehydes. Butyl is not recommended for halogen compounds, aliphatic or aromatic hydrocarbons, or applications that require the physical strength of natural rubber. This synthetic rubber provides the highest permeation resistance to gases and water vapors of any protective material used to make gloves.

DuPont™ Viton® is the most chemical resistant of all the rubbers and protects against toxic and highly corrosive chemicals. DuPont Viton gloves protect against polychlorinated biphenyls (PCB's), polychlorinated triphenyls, benzene and aniline. A flouroelastomer, DuPont Viton provides excellent resistance to aromatic and aliphatic hydrocarbons as well as chlorinated solvents. It is not recommended for ketones.

Heavyweight DuPont Viton is required for protection from physical hazards. It is primarily used when the life span of other gloves is too short to be economical.

CUT-RESISTANT GLOVES

Cut-resistant gloves provide protection against sharp objects such as glass and sharp metals. Gloves that provide cut resistance and cut protection do not completely prevent or eliminate the potential for cuts and punctures, and are not intended or tested to provide protection from powered blades, serrated or other sharp or rotating objects.

Cut resistance is a function of a glove material composition and weight (ounces per square yard). Cut protection can be influenced by the factors noted below. The more of these factors that can be engineered into a yarn, the more cut-resistant it will be.

- **Strength:** Examples can include high performance yarns such as DuPont™ Kevlar®, Dyneema®, Spectra®, etc.
- **Hardness (dulling):** An example of hard yarn would be stainless steel, which is often a primary component in engineered yarns.
- **Lubricity (slickness):** Yarns such as Dyneema and Spectra allow a blade to slide over the surface without cutting through.
- **Roll:** Most knit gloves allow the individual yarns to roll as a sharp edge slides over them.

Remember, there is no such thing as a cut-proof glove.

Cut Resistance and Testing

Globally, there are two different performance standards for cut resistance: the ANSI/ISEA 105 Standard for the U.S. and the European Standard EN388.

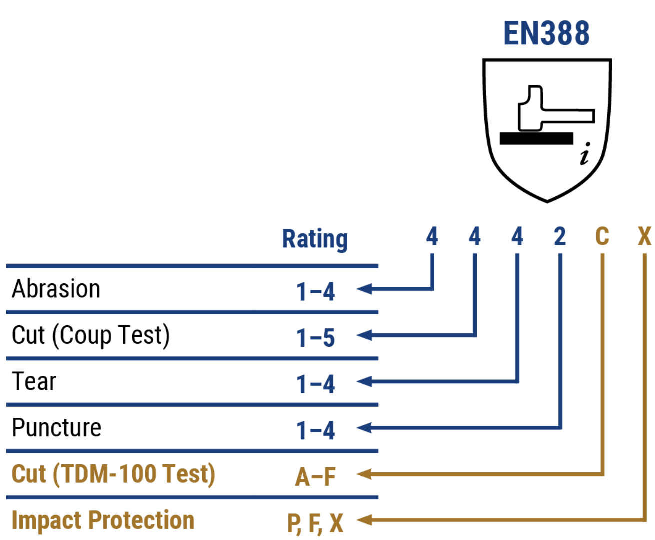
Cut level results of ANSI/ISEA and EN388 standards cannot be correlated. The testing methods are not identical, so when referring to a cut level, know which standard is being referenced in order to set the right expectations for performance and specifications.

ANSI/ISEA 105-2016 Ratings

The American National Standards Institute/International Safety Equipment Association (ANSI/ISEA) 105-2016 American National Standard for Hand Protection Classification is the latest revision of a standard first published in 1999, and revised in 2005 and 2011. This standard addresses the classification and testing of hand protection for specific performance properties related to chemical and industrial applications. It provides, or refers to, appropriate test methods and provides pass/fail criteria used by manufacturers to classify their products. End users can use this information to review the documentation received from their supplier to help verify the gloves they are considering meet their needs.

When tested using the Cut Performance Protection Test (CPPT), the glove's cut resistance is classified as A1-A9, as shown in the table below.

ANSI/ISEA 105 (2016)	
Weight (g) needed to cut through material: ASTM F2992/F2992M-15**	**Cut Level Rating**
>/= 200	A1
>/= 500	A2
>/= 1000	A3
>/= 1500	A4
>/= 2200	A5
>/= 3000	A6
>/= 4000	A7
>/= 5000	A8
>/= 6000	A9
Blade Travel ** 0.8" (20 mm of blade travel)	



EN388-2016 Ratings

The European Standard for Protective Gloves, EN388, is used to evaluate mechanical risks for hand protection and was updated on November 4, 2016. Gloves with an EN388 rating are third party tested, and rated for abrasion, cut, tear, and puncture resistance. Cut resistance is rated 1–5, while all other physical performance factors are rated 1–4. The EN388-2016 standard uses both the "Coup Test" and the "TDM-100 Test" to measure cut resistance for a more accurate score. Also included in the standard is a new Impact Protection test.

LEATHER GLOVES

Cuts of Leather

Grain: Grain leather is the smooth exterior side of the hide. It provides durability and dexterity.

Split: Split leather is the rougher interior side of the hide. The different types of split are side, shoulder or belly split.

- **Side Split:** Side split comes from the rib area of the animal. This part of the leather is the most durable and provides the greatest protection because of its greater density of fibers.
- **Shoulder Split:** Shoulder split is more economical than side split, but less durable. The additional movement of the animal in this shoulder area creates less fibers and a more visible texture difference.
- **Belly Split:** Belly split leather is the most economical; however it has the least consistency of texture and appearance.

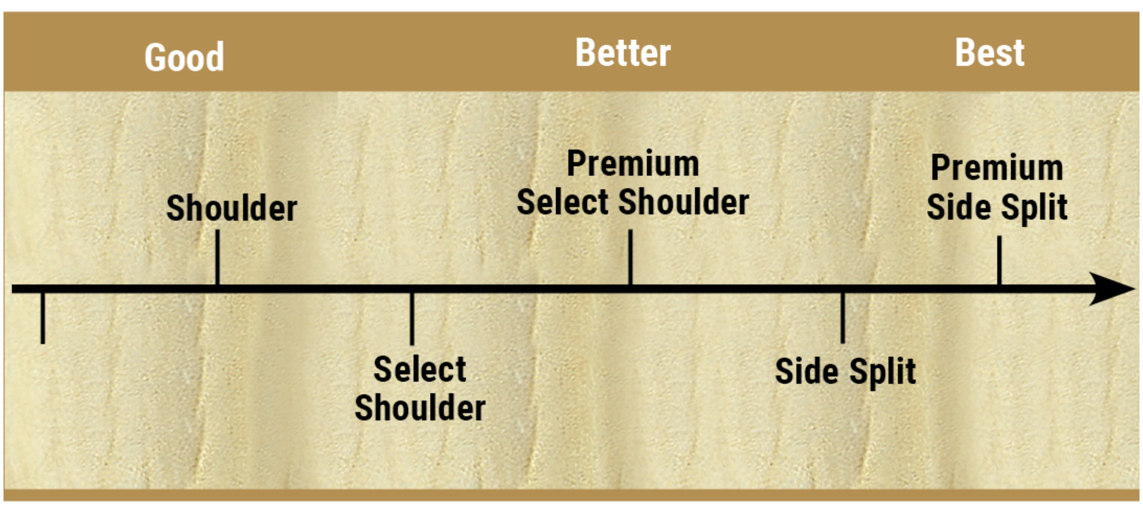
Leather Types

Cow: Cowhide is the most commonly used leather due to its abundance. Advantages include comfort, durability, excellent abrasion resistance and breathability.

Pig: Pigskin affords the greatest breathability due to its porous texture. Additionally, pigskin tends to become softer with use and withstands moisture without stiffening. When laundered, this leather will return more to its natural soft texture than other leathers.

Goat: Grain goatskin is twice as durable as cow grain and pig grain leather. The natural lanolin produced by goats helps to create the softest, most abrasion-resistant leather. Highly recommended for applications requiring tactile sensitivity.

Deer: Known to be one of nature's most luxurious, softest leathers, providing all-day comfort and sensitivity to touch.



Leather Type Comparisons

	Grain Pigskin	Grain Cowhide	Split Cowhide	Grain Deerskin	Grain Goatskin
Abrasion Resistance	Best	High	High	Fair	High
Puncture Resistance	High	Best	Best	Fair	High
Tensile Strength	Good	High	High	Best	High
Breathability	Best	Fair	Fair	Fair	Fair
Flexibility	High	Good	Fair	High	High
Tactile	High	Good	Fair	High	High
Insulation Ability	Low	Good	Good	Best	Low
Moisture Resistance	Best	Fair	Fair	Better	Good
Relative Cost	Low	Mid-Range	Low	High	Mid-Range

Protective Clothing and Outerwear

Clothing used for welding and cutting should be dark colored and tightly woven. Do not use oxygen to clean off clothing — this could result in a spark and/or flame. Matches and lighters should never be stored in the pockets of clothing when welding or cutting is taking place. Leather sleeves and gloves help to protect against burns. High top boots, made of leather, are recommended. See ANSI Z49.1-2012, Section 4.3 for more detailed guidelines.

THE NEED FOR FLAME-RESISTANT PROTECTIVE APPAREL

Every day, workers in the electrical maintenance, utilities, oil, gas, petrochemical and steel industries work in environments that may expose them to hazards that could cause severe or fatal burn injuries. Garments made with non-flame-resistant fabrics of untreated natural fibers or synthetic fibers can ignite and will continue to burn (until extinguished or until all flammable material is consumed) even after the ignition source has been removed. Synthetic fibers will melt and drip causing severe contact burns to the skin. The most severe burns are often the result of ignited garments and not the initial exposure.

Flame-resistant garments are intended to resist ignition, prevent the spread of flames, and to self-extinguish almost immediately upon removal of the ignition source. The use of flame-resistant garments will provide thermal protection at the exposure area and can dramatically reduce the severity of injuries, thus increasing the chance for survival.

A wide variety of flame-resistant fabrics are available on the market today. Important considerations in any flame-resistant protective apparel program are testing and standards requirements. Following are common performance standards and test methods related to flame-resistant protective apparel. Please consult reference documents for complete information.

Workplace First Aid Kits

ANSI Z308.1-2015 AMERICAN NATIONAL STANDARD | MINIMUM REQUIREMENTS FOR WORKPLACE FIRST AID KITS AND SUPPLIES

ANSI/ISEA Z308.1-2015 establishes minimum performance requirements for first aid kits and their supplies that are intended for use in various work environments. Classification of first aid kits, designating the assortment of items and quantity of each item, is based on the anticipated number of users intended to be served by each first aid kit, as well as the complexity of the work environment and level of hazards. First aid kit containers are classified by portability, ability to be mounted, resistance to water, corrosion and impact.

The 2015 edition designates two classes of first aid kits, based on the assortment and quantity of first aid supplies.

> **Class A Kits:** Provide a basic range of products to deal with most common types of injuries encountered in the workplace.
>
> **Class B Kits:** Provide a broader range and quantity of supplies to deal with injuries encountered in more populated, complex and/or high risk workplace environments.

OSHA 1910.151 APPENDIX A

The contents of the kit listed in the ANSI standard should be adequate for small worksites. When larger operations or multiple operations are being conducted at the same location, employers should determine the need for additional first aid kits at the worksite, additional types of first aid equipment and supplies, and additional quantities and types of supplies and equipment in the first aid kits.

In a similar fashion, employers who have unique or changing first-aid needs in their workplace may need to enhance their first-aid kits. The employer can use the OSHA 300 (Log of Work-Related Injuries and Illnesses), 300A (Summary of Work-Related Injuries and Illnesses) and 301(Injury and Illness Incident Report) forms. Consultation from the local fire/rescue department, appropriate medical professional or local emergency room may be helpful to employers in these circumstances.

By assessing the specific needs of their workplace, employers can ensure that reasonably anticipated supplies are available. Employers should assess the specific needs of their worksite periodically and augment the first aid kit appropriately.

First aid supplies are required to be readily available under OSHA paragraph 1910.151(b).

BURN INJURY CLASSIFICATIONS

Burns are classified as first-, second- or third-degree, depending on how deep and severe they penetrate the skin's surface.

First-Degree Burns | Superficial

First-degree burns affect only the epidermis, or outer layer of skin. The burn site is red, painful, dry and with no blisters. Mild sunburn is an example. Long-term tissue damage is rare and usually consists of an increase or decrease in the skin color.

Second-Degree Burns | Partial Thickness

Second-degree burns involve the epidermis and part of the dermis layer of skin. The burn site appears red, blistered and may be swollen and painful.

Third-Degree Burns | Full Thickness

Third-degree burns destroy the epidermis and dermis. Third-degree burns may also damage the underlying bones, muscles and tendons. The burn site appears white or charred. There is no sensation in the area since the nerve endings are destroyed.