



**PERSONAL
PROTECTIVE
EQUIPMENT FOR
ELECTRIC ARC
WELDERS**



european-welding.org

Weld well!

2025/12

INTRODUCTION

EWA-European Welding Association

The European Welding Association (EWA) is an industrial body made up of national associations and manufacturers of arc welding and cutting equipment, welding consumables, flame welding and cutting equipment and health and safety equipment for welders from all over Europe.

EWA was founded in 1987. Its predecessor was the Association of European Manufacturers of Welding Consumables (CEFE), founded in 1958. EWA's current official headquarters are in Paris.

EWA Commitments and Objectives

EWA monitors the mutual technical and economic interests of the European welding industry and its customers by:

- Contributing to the development and application of all the relevant specifications and standards with a bearing on the welding industry, working hand-in-hand with the trade organizations, EU authorities and every other body concerned.
- Gathering and analyzing industry-specific market data
- Promoting the welding industry and welding as a profession.
- Encouraging the safe use of welding and cutting processes

Since 2018 EWA has been registered with the EU Transparency Register (ID number 711840531940-21)

EWA Technical Committees

The EWA technical committees work on every technical detail of the welding manufacturing process. At present, there are 4 technical committees:

- EWA TC Equipment (Arc welding/cutting equipment)
- EWA TC Consumables (welding consumables)
- EWA TC Flame equipment (oxy-fuel)
- EWA TC HSE (Health and safety equipment for welders)

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1. INTRODUCTION

Statistics on fatal and major work accidents underline the importance of protection and prevention, for which personal protective equipment plays an important role.

Performing welding, cutting or heating operations under inadequate conditions generates risks associated with:

- Fumes (smoke, dust, vapors, gases)
- Fire (use of flames, pressurized gas)
- Radiation (UV)
- Projections / Sparks
- Heat
- Falling objects
- Noise
- Electrical hazards
- Electromagnetic fields



To prevent these risks, priority must be placed on collective protection and Personal Protective Equipment (PPE) must be used when collective protection cannot be used or are not sufficient on their own.

Since 21 April 2018, with respect to personal protective equipment, the Directive 89/686 / EEC on PPE has been replaced by the new Regulation (EU) 2016/425. The new legislation furthers the improvement of PPE safety by requiring that all PPE sold on the European market complies with the Regulation (EU).

Major changes from 21/04/2018 include:

- Change of categorization from product-related to risk-related
- Change of classification for some product categories
- EU Declaration of Conformity to be enclosed with each product (or a link to where it can be obtained)
- Technical documentation held for 10 years after the PPE has been put on the market
- 5-year validity / expiry date given for new certificates
- Marking of all PPE products with correct markings and postal address
- Delivery of every PPE with a translation of the User Instructions for every country

Risk Categories for Personal Protective Equipment (PPE) in accordance with Regulation (EU) 2016/425

- Category I - minimal risks - low protection requirements
- Category II - moderate risks - includes risks other than those listed in Categories I and III
- Category III - high risks - protection against irreversible damage and deadly hazards

2. THE RISKS AND THE SOLUTIONS

<p>FACE & EYES</p> <p>During arc welding, the air (shielding gas) between the electrode and the workpiece is ionized by an electrical voltage and plasma is formed.</p> <p>In addition to visible light, this produces infrared radiation and ultraviolet radiation, which are hazardous to the eyes and the skin</p>		<p>WELDING HELMET & HAND SHIELD</p> <p>Two different main types - passive shields with fixed-shade lenses and helmets with auto-darkening filters (ADF) which adjust the shade level base on the light intensity. Protection against UV & IR radiation</p> <p>SAFETY GLASSES</p> <p>These are used in addition to the helmet or shield to protect the eyes against mechanical particles</p>
<p>AIRWAYS & LUNG</p> <p>Harmful gases and particulate substances are produced during all arc welding processes and cause chemical risks</p>		<p>PAPR SYSTEM</p> <p>A Powered Air Purifying Respirator (PAPR) is a system that uses a fan to deliver filtered air into a variety of headgear</p>
<p>BODY</p> <p>Risks for the body such as wounds and burns</p>		<p>WELDING JACKET</p> <p>Welding jacket of flame-resistant material or leather to protect the upper body against metal and slag spatter, UV radiation, heat, and brief contact with hot surfaces</p>
<p>HEAD & NECK</p> <p>Risks from flying hot particles that can cause burns and wounds</p>		<p>WELDING HOOD & NECK PROTECTION</p> <p>It protects head and neck against welding spatter and arc radiation</p>
<p>HAND AND FOREARM</p> <p>Risks for the hand and forearm such as burns and other wounds</p>		<p>WELDING GLOVES</p> <p>The choice of welding gloves depends on the welding application in order to offer the right protection and comfort</p>
<p>LEGS</p> <p>Risks for the legs such as burns and other wounds</p>		<p>WELDING TROUSERS</p> <p>Welding trousers of flame-resistant material or leather to protect the lower body against metal and slag spatter, UV radiation, heat, and brief contact with hot surfaces</p>
<p>FEET</p> <p>Risks are perforations, falling object, burns and slipping</p>		<p>SHOES</p> <p>Safety shoes provide protection for the feet and the lower part of the leg</p>

3. PROTECTION AGAINST RADIATION, HEAT AND BURNS: WELDING HELMETS

The welding arc emits light in the visible, infrared (IR), and ultraviolet (UV) fields. The intensity of this light is so high that the human eye cannot easily process it. Furthermore, the energy density is high and can cause damage to the skin and eyes due to the radiation's heat impact. Welding helmets are practical protection equipment used to shield the eyes from UV, IR, and visible light produced by the welding process. Additionally, welding helmets are designed to protect against mechanical impacts from debris (e.g., during grinding). Impact levels are indicated with the letters C to E, where Level C represents resistance to a sphere weighing 0.86 g at 45 m/s, while Level E is at 120 m/s.

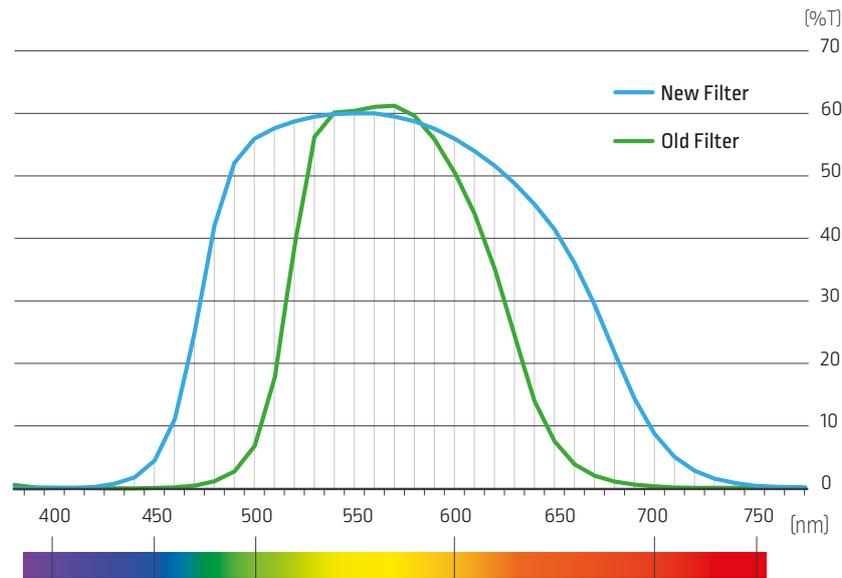
ISO 19734 provides a general guide on the selection, use, and maintenance of eye and face protection, covering topics such as visible, IR, UV, mechanical, and chemical impacts, among others. For welding, the shade number is the most relevant indicator. The shade number describes the darkness of a protection glass - the higher the shade number, the darker the glass. The table below summarizes the recommended shade numbers for different processes and currents.

Process	Ampere																			
	1.5	6	10	15	30	40	60	70	100	125	150	175	200	225	250	300	350	400	450	500
MMA 	8				9			10		11			12			13			14	
MIG heavy metals 								9		10		11			12		13		14	
MIG light metals, Al, Stainless 										10		11		12		13		14		
TIG 				8		9		10		11			12		13					
MAG 	8				9			10		11			12			13				
Plasma cutting 								9		10		11		12		13				
Micro plasma welding 	4	5	6	7	8	9	10	11		12										

Recommended shade level chart according to EN169. Depending on the welder's perception a higher or lower shade number can be used.

Welding shields, consisting of a metal or plastic part with a handle and a viewing port with dark glass, are the earliest eye and face protectors for welders. The challenge is that without the welding arc, it is difficult to see the workpiece. With a helmet, the entire darkening glass can be removed by opening the complete helmet or flipping the dark glass part alone. Flipping can be to the outside or inside of the helmet.

Automatic Darkening Filters (ADF) have the ability to change the shade number. Typically, they have an open state and a dark state. In the last decade, the dark state and the bright state have been extended by novel technologies, allowing the ADF to be used in a broader set of applications. The latest generation of welding filters can also detect brightness and adjust the shade number automatically. Desired sensitivity for the offset and the delay of the opening (from dark state to open state) are additional functions offered by these helmets. Passive UV and IR filters always provide the welder with protection from potential hazards. Even without batteries, the ADF will protect from UV and IR. In the past, welding gases turned the viewed scene into a green hue; new filters allow a broader spectrum of visible light to pass. This enables the welder to see truer colors, improving the visibility of the weld pool and temperature color, thus giving a better perceived sense of the temperatures and significantly increasing work satisfaction.



Example of two different ADFs, the new generation has a much broader transmission (source LINCOLN ELECTRIC)

For ADF, the arc detection is provided by an array of sensors. Specialized helmets are equipped using a technology that can connect to the welding equipment; before welding starts, the welding machine sends a trigger to a connected helmet, and the ADF darkens a few milliseconds before welding arc formation and opens the ADF when the weld is completed. This is especially helpful when the sensors are blocked (e.g., in confined spaces) or when there are false triggers in the room (e.g., other welders or lamp reflections).

When choosing a helmet, the field of view may vary between different models. The field of view depends on the ADF size and the distance of the ADF to the eyes. ADFs with a nose cutout are intended to bring the ADF closer to the eye, allowing a greater field of view with the same-sized ADF.

The helmet becomes significantly heavy when worn for several hours. The lighter the helmet, the more convenient it is to be worn by the welders. A hard hat typically adds a lot of weight to a welding helmet with an integrated hard hat. For this reason, welders are often exempt from wearing a hard hat during welding operations and must change headgear when moving between places. This is often impractical, and therefore manufacturers of protection equipment have developed new hard hat solutions for welding helmets that save weight.

Some helmets also offer a connection to an air purification system. Typically, the purification system is connected to a helmet system from the same manufacturer. This is necessary since the system is certified as an entire system and not just the components. When selecting a helmet (or vice versa), the compatible blowers are limited. Therefore, when making a helmet choice, respiratory protection should also be taken into consideration. More information is given in the section headed "Protection against fumes" below.

4. PROTECTION AGAINST FUMES: EXTRACTION SYSTEMS AND HELMETS WITH INTEGRATED AIR SUPPLY

During electric welding processes, especially when using MIG-/MAG-processes or stick electrodes, hazardous substances are given off in the form of welding fumes. The type and quantity of these hazardous substances depend on the material, the process used and the intensity/performance of the process.

The European Directive 2004/37/CE on the protection of workers, reporting the risks related to exposure to carcinogens, mutagens or substances toxic to reproduction (CMR) at work reported some of the welding gases to be dangerous and recommends protecting people from inhaling them, especially when people exposed to those fumes more frequently.

To protect people, the greatest efforts must be made first to reduce the production of these hazardous substances and second, to extract the fumes as close as possible to the point of origin. More information and suggestions will be found in the EWA brochure "Introduction to methods of reduction and extraction of welding fumes"

In addition, or if these options cannot be used, welding safety helmets with an integrated air supply also offer good welder protection since such helmets offer protection from three possible sources - fumes, visible and invisible radiation, and impact from small solid parts.



¹Link to: EWA brochure «Methods-of-prevention-and-extraction-of-welding-fumes»

Four personal protection different masks or helmet systems are available. Each protection type typically has 3 classes, 1, 2 and 3, with 3 being the highest (e.g. FFP3, TH3). A good way to determine the need concerned is the nominative protection factor (NPF) which shows how much a danger is reduced when correctly using the device. The following regulatory references give increasing protection levels:

STANDARD	TITLE	CLASS DESIGNATION	NPF
EN 149	Filtering half masks to protect against particles	FFP1 - FFP3	4 - 50
EN 140	Respiratory protective devices - Half masks and quarter masks - Requirements, testing, marking	P1 – P3	4 - 48
EN 136	Respiratory protective devices - Full face masks - Requirements, testing, marking	P1 – P3	5 - 1'000
EN 12941	Respiratory protective devices - Powered filtering devices incorporating a helmet or a hood	TH1 – TH3	10 - 500
EN 12492	power assisted filtering devices incorporating full face masks, half masks or quarter masks	TM1 – TH3	20 - 2'000
EN 14594	Respiratory protective devices - Continuous flow compressed air line breathing devices	1A or 1B until 4A or 4B	10 - 2'000

An NPF greater than 100 is recommended for welding professionals. Respiratory protection can be achieved through passive respirators, which do not require any energy, or active respirators, where air is driven through a filter by means of a blower. These active respirators are known as Powered Air Purification Respirators (PAPR). Typically, PAPRs are battery-powered devices with a motor that transports a controlled amount of air, usually between 100 to 250 L/min, through a High-Efficiency Particle Filter (HEPA). The filtered air is delivered to the headpiece via a hose. Different headpieces are available, including hoods, helmets, or full-face masks. Welding helmets with integrated eye protection are designed to meet the specific needs of welders (see previous chapter: Protection against radiation, heat, and burns: welding helmets). These helmets are certified for one or several classes, such as TH, TM, A, or B. Gradually as the filter clogs, the blower adjusts the airflow to ensure the user's protection class is maintained. If the required air cannot be provided, an alarm will sound, indicating that the filter needs to be replaced. In typical welding applications, the filter needs to be replaced once a year. In environments with high air pollution, more frequent replacements may be necessary.

In the personal protection market, PAPRs can be mounted on the user's back, head, or neck. Depending on their size and weight, this can affect comfort and perceived mobility, especially when using extension kits, such as when adding gas filters to the unit.

The main component of welding fumes is solid particles, which can be filtered using particle filters. During welding, gases are also produced, a prominent example being ozone, which gives the welding area its distinct sharp, pungent odor, much like chlorine bleach. These gases are not filtered by particle filters; instead, a gas filter can be used. For welders, an ABE-type gas filter is recommended. The letters A, B, and E

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represent the types of gases they can filter: A for organic gases, B for inorganic gases, and E for acidic gases. Additional gas filters are available for AX (low boiling-point organic gases), K (ammonia), NO, NO₂ (nitrous oxides), and Hg (mercury). Gas filters are made of activated carbon, which absorbs the influent gases on its surface. The filtering capacity is indicated by a number after the letter, with 1 being low capacity, 2 being middle capacity, and 3 being high capacity. The letters can be combined freely, e.g., A1B2E3 (note: not a typical filter). Gas filters work only for gases that can be smelled. The capacity limit is reached when the user smells the gas under the helmet, indicating that the gas filter needs to be replaced. For protection against odorless gases, special protection with chemical sensors on the respirator is needed, or air from a supply line should be used.

Ozone is the most frequently harmful gas. Eliminating the inhalation of ozone has been reported to elevate the perceived quality of life for welders. Filtering ozone is not very difficult; most gas filters can filter ozone easily, and in many cases, an odor filter or even a particle filter can eliminate a significant portion of the influent ozone. The efficiency of ozone elimination is typically not well documented, but users can evaluate the efficacy themselves. If the typical ozone smell vanishes under the welding helmet, effective ozone filtering has been achieved. If this is not the case, an odor filter may help.

For extensive maintenance or cleaning tasks conducted within a defined workplace, supplied air systems offer a reliable alternative to Powered Air-Purifying Respirators (PAPR). These systems are generally lighter and require less maintenance. A belt-mounted supplied air system delivers breathable air from a compressed air source – such as a compressor or an airline system (certified according to EN 12021 - “Respiratory equipment – Compressed gases for breathing apparatus”). The system reduces the air pressure to a safe, breathable level and supplies it through an air hose into the helmet.



5. PROTECTION AGAINST NOISE: EAR PROTECTION

Noise can be harmful to health: not only leading to hearing impairment but causing other unwanted, and long-lasting, negative effects (psychological and social issues, fatigue, cardiovascular problems...).

The European standards are grouped together in two series:

- The three parts of the EN 13819 series, 'Hearing protectors – Testing' series
- The ten parts of the EN 352 series, 'Hearing protectors – Safety requirements' series

The hearing protectors are classified in Noise Reduction Rating (NRR). The higher the NRR, the more sound can be blocked.

Make workplace measurement measuring the frequency and amplitude of the noise your chosen basic choice of hearing protector.

6. PROTECTION AGAINST RADIATION AND HEAT: FLAME-RESISTANT MATERIAL AND LEATHER CLOTHES

For adequate overall protection against the risks to which welders are likely to be exposed, personal protective equipment (PPE) has to be worn to protect the body and legs.

Typical EN Standards for welding clothes are:

- European Regulation on Personal Protective Equipment (EU) 2016/425
- EN ISO 13688:2013: general requirements for ergonomics, innocuousness, size designation, ageing, compatibility and marking of protective clothing
- EN 1149-5:2018: Protective clothing - Electrostatic properties, material performance and design requirements
- EN ISO 11611:2015: specifies minimum safety requirements and test methods for protective clothing worn during welding and allied processes
- EN ISO 11612:2015: Protective clothing - Clothing to protect against heat and flame - Minimum performance requirements
- EN 61482-2:2021: Protective clothing against the thermal hazards of an electric arc

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Clothing produced according to EN ISO 11611 serves to protect the wearer whilst welding or performing allied processes involving comparable risks. This clothing provides protection against spatter (minor splashes of molten metal) and so-called welding beads as well as brief contact with flames and radiant heat from the arc. Under normal welding conditions, it offers limited electrical insulation against DC voltage of up to approximately 100 V.

 <p>EN ISO 11611</p>	Class 1	is protection against less hazardous welding techniques and situations, causing lower levels of spatter and radiant heat.
	Class 2	is protection against more hazardous welding techniques and situations, causing higher levels of spatter and radiant heat.
	A1	indicates that the garment meets the requirements for limited flame spread for surface ignition
	A2	indicates that the garment meets the requirements for limited flame spread for bottom-edge ignition

Clothes commonly used for welding:

- Jackets
- Aprons
- Sleeves
- Trousers
- Hoods
- Gaiters, ...



7. PROTECTION AGAINST RADIATION AND HEAT: GLOVES

Welding gloves are mainly made of leather. The materials must have undergone specific tests regarding the thermal risks associated with welding.

European Directive (UE) 2016/425: harmonization of member states' PPE legislation.

- EN 21420 Protective gloves - general requirements
- EN 12477:2001+(A1:2005) Protective gloves for welders
- EN 388:2019 Protective gloves against mechanical risks
- EN 407:2020 Protective gloves against thermal risk



Mechanical performance according to EN 388:2016

The following pictograms are used to describe protection against thermal risks – letters A to F indicate the performance levels for different tests. A “0” under the pictogram means that the glove did not meet the minimum requirements for the test, and an “X” means that a test was not performed or is not applicable.

<p>EN 388:2016</p>  <p>ABCDEF</p>	<p>A ... Abrasion resistance (0-4) B ... Cut resistance - Coup test (0-5) C ... Tear resistance (0-4) D ... Puncture resistance (0-4) E ... Cut resistance according to ISO 13997 (A-F) F ... Impact resistance / The impact resistance test is optional, with a pass result indicated by a 'P'</p>
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Thermal performance according to EN 407:2020

The following pictograms are used to describe protection against thermal risks – letters A to F indicate the performance levels for different tests. A “0” under the pictogram means that the glove did not meet the minimum requirements for the test, and an “X” means that a test was not performed or is not applicable.

<p>EN 407:2020</p>  <p>ABCDEF</p>	<p>A ... Limited flame spread (0-4) B ... Contact heat resistance (0-4) C ... Convective heat resistance (0-4) D ... Radiant heat resistance (0-4) E ... Resistance to small splashes of molten metal (0-4) F ... Resistance to large quantities of molten metal (0-4)</p>
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<p>EN 407:2020</p>  <p>ABCDEF</p>	<p>A ... Limited flame spread (0-4) B ... Contact heat resistance (0-4) C ... Convective heat resistance (0-4) D ... Radiant heat resistance (0-4) E ... Resistance to small splashes of molten metal (0-4) F ... Resistance to large quantities of molten metal (0-4)</p>
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The ‘flame’ icon can be applied to products that have achieved at least level 1 performance in the limited flame-spread test. The ‘hot contact’ icon is used if the glove has not been tested for this.

8. PROTECTION AGAINST RADIATION AND HEAT: SHOES

European Regulation UE 2016/425 of March 9, 2016 stipulates that wearing safety shoes is compulsory for workshop work. Furthermore, the use of suitable safety shoes protects feet from the risk of falling objects but also from the specific risks of arc processes, like hot projections or liquid metal in the cutting process.



The EN ISO 20345 standard describes several levels of protection:

The criteria of choice are:

1 - The level of protection according to the standard EN ISO 20345 :2024

2 - High or low shoes

3 - Upper in:

- full-grain leather (water resistant)
- split leather
- fabric (no water resistant)
- pigmented split leather

4 - Outsole:

- PU+PU (dual density polyurethane lightweight)
- PU+TPU (lightness and flexibility + more strength of the thermoplastic polyurethane)
- PU + nitrile rubber for extreme temperatures (up to 300 °C)

5 - Puncture-proof midsole:

- in steel
- no metallic for more comfort

6 - Toe protection:

- steel
- aluminum (30% lighter)
- fiberplast (extra lightweight)

The EN ISO 20344-1:2021 specifies requirements and test methods for footwear protecting users against risks, such as those encountered in foundries.

9. OTHER IMPORTANT NOTES

1. For all type of protection, refer also to the national regulations

2. For the electric hazard / see the EWA recommendations :

https://european-welding.org/wp-content/uploads/2021/01/TI-2021-english-Electrical-Hazard_V1_-1.pdf

3. For EMF risks / see the EWA recommendations :

<https://european-welding.org/wp-content/uploads/2023/04/2023-04-Fact-sheet-on-EMF-in-welding-.pdf>

4. In case of medical implants / see the EWA recommendations :

https://european-welding.org/wp-content/uploads/2024/01/Safety-sheet_Medical-implants.pdf



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