How Do 3M Auto-Darkening Filters for Welding Helmets Work?

A look inside the technology

Auto Darkening Welding Helmets Auto-darkening welding helmets were designed to make welding protection easier and safer. If you can always see clearly, the need to constantly lift your welding mask is reduced. This, in turn, means a reduced likelihood of injury from foreign bodies such as welding sparks and metal, and reduced potential exposure to harmful UV/IR radiation by accidentally striking an arc or being exposed to the arcs of others welding nearby.

But how do they work?

What Components Make Up An Auto Darkening Welding Lens?

There are a number of different elements which combine to create 3M auto-darkening filters for welding helmets. Let's take a look at each of the elements and then how they work in combination to protect your eyes from harmful UltraViolet/InfraRed (UV/IR) radiation.

1) UV/IR Interference Filter: The UV/IR filter effectively eliminates significant levels of UV/IR radiation, even when the Auto-Darkening Lens is not activated. The UV/IR filter comprises numerous metallic layers (5 silver layers, 6 aluminium oxide layers) and a thin glass substrate. With the help of the metallic layers, the filter has the ability to reflect and absorb 99.9% of the IR radiation within the ADL shade range. This helps to not only protect the wearer's eye from harmful radiation, but also to protect the liquid crystal panels from any heat damage due to the high temperatures present during welding. The UV protection offered by the ADL is a result of the metallic layers working in combination with the polarisation filters – allowing the lens to absorb 99.9997% of harmful UV radiation within its shade range. The glass absorbs the harmful UVB radiation (the type that causes sunburn), while the polarising filters and UV/IR filter remove UVA radiation which can penetrate glass, but is harder to detect. It is these metallic layers, when combined, which gives auto-darkening welding lenses a metallic reflective purple colour – as seen on Speedglas welding helmets.

2) Polarisation Filters: Polarisation filters darken the visible light when used in combination with the UV/IR filter and LCC's. As seen in the image above, the polariser nearest the UV/IR filter is perpendicular to the other two polarisers. When two polarisers are positioned at an angle of 90 degrees they will be at their darkest. By contrast, when the polarisers are arranged in the same orientation the light will only darken slightly. Basically, the degree to which the light is darkened depends on which way they are being moved.

3) LC Cell Liquid Crystal Cells (LCC): Liquid Crystal Cells have the ability to turn the light. When lying flat, liquid crystal cells twist the light by 90 degrees. However, when stimulated by electricity, it is possible to manipulate how far the LCC's bend the light.

So How do Auto Darkening Lenses Work? Now that you understand the components, here's how they all work together to give you a functioning ADL! Using the image above, you will notice that the 2 polarising filters closest to the welder's eye (the right-hand side of diagram) are aligned in the same direction. When the welding lens is switched off, the liquid crystals between the polarising filters bend the polarised light 90 degrees, meaning the lens will appear dark (around shade 5-6). This is a built-in safety feature that protects the eyes from very bright light in the event of the auto-darkening lens failing.

Conversely, when switched on, the liquid crystal cell between the first two polarisers un-twist the polarised light waves, causing the lens to drop down to a light shade of 3 before striking an arc. If this does not happen, do not continue welding as there is a problem with your ADL! Within 0.1 milliseconds of the arc being struck, the photosensors on the front of the lens activate the front liquid crystal panel which darkens the lens to your pre-selected dark state. The lens will then automatically return to the clear state after the weld is complete, allowing for immediate and safe inspection of the weld pool and preparation for the next weld.

Find an auto-darkening helmet to suit your needs Visit: https://www.awsi.com.au/speedglas-welding-helmets to find the helmet that's right for you!

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