3M™ Scotchgard™ Anti-Fog

Technology Overview.

Products included

- SecureFit™ 600
- Solus™ 1000
- Goggle Gear™ 500

Product Description

3M™ Scotchgard™ Anti-Fog provides advanced anti-fog, anti-scratch properties designed to enhance eyewear performance. The 3M™ Scotchgard™ Anti-Fog coating helps keep lenses clear in rugged, dusty, steamy and wet environments providing at least 12 times longer lasting fog resistance than traditional anti-fog, anti-scratch coatings. Designed for the toughest environments, 3M™ Scotchgard™ Anti-Fog also features an anti-static property which helps keep dust, dirt and particles from sticking to the lens.

Key features

- Helps keep lenses clear, longer
- Less down time needed to wipe lenses
- Lasts at least 12 times longer than traditional anti-fog coatings when tested to the EN166 Standard, Clause 7.3.2, Resistance to fogging
- Anti-static property helps keep dust from sticking to the lens
- Lasts at least 25 washings with water
- Anti-scratch properties meeting the K mark requirements of European standard EN166 Clause 7.3.1
- Meets the anti-fog requirements of the European N mark testing (EN166 Clause 7.3.2)

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3M™ Scotchgard™ Anti-Fog Resistance to surface damage by fine particles.

There are a number of test methods available that are designed to assess a lens’ ability to resist surface damage.

In Europe, the EN 166 test method includes an optional requirement for ‘resistance to surface damage by fine particles’.

In this test, the diffusion of light through the lens is measured before and after the lens is subjected to conditioning involving falling sand. Products which comply with this requirement carry a K mark on their lens.

3M™ Anti-Scratch coating provides superior protection to lens surfaces and therefore complies with the K mark requirements of the European test standard EN 166.

Test method:

- Conditioned and tested in accordance with EN 166:2001 Clause 7.3.1 Resistance to damage by fine particles.
- Testing conducted by Inspec Plc. As per the requirements of the standard, 4 samples were used in the testing

Surface damage by abrasion

In order to assess the abrasion resistance of lens coatings, 3M has performed extensive comparative tests using industry-recognised methods. In these tests, abrasion was simulated using specified equipment. The amount of surface damage was represented as a change in light diffusion through the lens; the smaller the change, the better the performance.

- 1% - 3M™ RAS
- 11% - Generic Anti-Scratch
- 24-31% - Generic Anti-fog, 3M™ Scotchgard AF, DX
- 55% - Uncoated Lens

Test method:

- Test based on US Military Combat Eye Protection System GL-PD 10-12 Section 4.3.3.4.3.1 Abrasion Resistance.
- Sample eyewear is placed on the Taber Linear Abrader and rubbed with wear-eraser for 20 cycle with 750 g additional weight on the abrader arm. Haze of the abraded track is then measured using BYK-Gardner haze-gard plus with a reduced 1/4” opening. The percent haze gain is the difference between the haze readings taken before and after the abrasion. Lower haze change indicates improved abrasion resistance.
- Tested was conducted in 2012 by 3M. Results for 3M™ Scotchgard™ Anti-fog lenses were averaged from a batch of 141 models. With the expection of the 3M™ Scotchgard™ Anti-fog lenses, five samples were tested from each set and the haze change value was then averaged.
**3M™ Scotchgard™ Anti-Fog**

Resistance to fogging.

Fogging on a lens is assessed from the point-of-view of the wearer i.e. does fogging interfere with vision. This property is assessed quantitatively through measurement of the change in light transmittance through the lens. Both EN166 and ASTM F659 use 80% of the original transmittance as a minimum acceptable level. To achieve the EN166 N mark, the change in transmittance must remain above 80% for a minimum of 8 seconds. In the ASTM standard, a minimum of 30 seconds must be achieved.

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**Anti-fog performance of coatings over time**

![Graph showing anti-fog performance of coatings over time](image)

**Scotchgard™ Anti-Fog**

80% Transmittance limit

**Generic anti-fog coating**

8 seconds (EN166: 2001) 30 seconds (ASTM F659-10)

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**3M™ Scotchgard™ Anti-Fog**

Static charge dissipation.

Static charge can be the result of natural events such as body movements that cause objects to rub against each other. A build-up of static charge on a lens can cause problems because dust and other small particles may be attracted to the lens surface, reducing visibility.

<table>
<thead>
<tr>
<th>Coating</th>
<th>Immediately after Neutralization</th>
<th>Immediately after 20 Rubs with Micro Fiber Cloth</th>
<th>After 5 minutes</th>
<th>After 15 minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scotchgard™ Anti-Fog Coating</td>
<td>0</td>
<td>+500</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Uncoated Lens</td>
<td>0</td>
<td>+5000</td>
<td>+5000</td>
<td>+5000</td>
</tr>
</tbody>
</table>

**Test method:**

- A static neutralizer was used to remove existing charge from eyewear samples (confirmed by an initial measurement).
- A charge was induced on the lens by rubbing them 20 times with a microfiber cloth.
- Subsequent charges were then measured as the intervals of 0.5 minutes, 5 minutes and 15 minutes while the lens sits in air at 72°F/-5°F and 50% +/-10% RH.
- The eyewear was allowed to dry at room temperature and 50% +/- 10% RH for 1 hour.
- The samples were then tested for up to 60 seconds on the EN168 Fog Tester and their “time until fogging” was determined (time until the transmittance of the test sample is reduced to 80% of its original transmittance when exposed to the humid air above a water bath at 50°F).
- Resistance to fogging was assessed using 3M Maxim lens, one uncoated and one coated with 3M Scotchgard™ Anti-Fog.

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**Resistance to disinfection with Isopropyl Alcohol (IPA)**

Isopropyl Alcohol (IPA) can be used as a mild disinfectant and general cleaning solution. Lens cleaning solutions, such as those sold by 3M, often contain varying amounts of IPA. To ensure that this chemical did not adversely affect the anti-fog properties of 3M Scotchgard™, samples were wiped with tissues saturated in a solution of IPA in water (70%), rinsed, dried and then assessed for fogging.

**Test method:**

- Sample eyewear was wiped with a household paper towel saturated with a 70% solution of IPA in water.
- The eyewear was allowed to dry at room temperature and 50% +/- 10% RH for 1 hour.
- The samples were then tested for up to 60 seconds on the EN168 Fog Tester and their „time until fogging” was determined (time until the transmittance of the test sample is reduced to 80% of its original transmittance when exposed to the humid air above a water bath at 50°F).
- The samples were then tested in 2012 by 3M using a single sample coated with 3M Scotchgard™ Anti-fog

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**Cleaning and disinfecting with IPA does not affect the anti-fog performance of lenses coated with 3M Scotchgard™ Anti-Fog. After conditioning, lenses still provide fog resistance for over 60 seconds.**

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**Notes:**

- For cleaning and disinfection, please follow product user instructions, manufacturer recommendations and site specific procedures.
Cleaning of spectacles and goggles is a necessary part of using them but the unfortunate truth is that even washing with water can degrade some lens coatings. During development of the 3M™ Scotchgard™ Anti-Fog coating, simple wash tests were used to assess the durability of various coatings.

Eyewear is often used in environments where it is exposed to substances that could potentially pose a biological hazard. Many proprietary disinfectants are used in medical and industrial workplaces, often featuring Sodium Hypochlorite as a base ingredient. Unfortunately, this chemical can have a detrimental effect on both lenses and lens coatings. To assess the resistance of Scotchgard, lens samples were conditioned in a Sodium Hypochlorite solution (0.6%), rinsed, dried and then assessed for fogging.

### Resistance to washing using water.

3M™ Scotchgard™ Anti-Fog can withstand at least 25 washes with water without a reduction in the performance of its anti-fog properties.

<table>
<thead>
<tr>
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<th>0 Wash Cycles</th>
<th>1 Wash Cycles</th>
<th>5 Wash Cycles</th>
<th>10 Wash Cycles</th>
<th>25 Wash Cycles</th>
</tr>
</thead>
<tbody>
<tr>
<td>3M™ Scotchgard™ Anti-Fog Coating</td>
<td>&gt; 60</td>
<td>&gt; 60</td>
<td>&gt; 60</td>
<td>&gt; 60</td>
<td>&gt; 60</td>
</tr>
<tr>
<td>Generic Coating</td>
<td>&lt; 10</td>
<td>&lt; 10</td>
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### Resistance to disinfection with bleach.

3M™ Scotchgard™ Anti-Fog has excellent resistance to degradation caused by disinfection with bleach. After conditioning, lenses still provide fog resistance for over 60 seconds.

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**Test method:**

- Sample eye wear was immersed for 10 seconds in solution of 10% household bleach (6% diluted down to 0.6% Sodium Hypochlorite) in tap water at 72°F +/- 5°F.
- The lenses on the eye wear were rinsed off in tap water at 72°F +/- 5°F for 5 seconds, dried with a household paper towel, and allowed to further dry for 1 hour at 72 +/- 5°F and 50 +/- 10% RH.
- The samples were then tested for up to 60 seconds on the EN168 Fog Tester and their “time until fogging” was determined (time until the transmittance of the test sample is reduced to 80% of its original transmittance when exposed to the humid air above a water bath at 50°F).
- Testing conducted in 2012 by 3M. Two samples were used in this testing.
- Note: For cleaning and disinfection, please follow product user instructions, manufacturer recommendations and site specific procedures.