Fog forms on a facepiece lens when water vapor condenses into fine droplets on the surface of the lens. Fogging is not uncommon as there are multiple factors that can lead to fogging that vary across the respirator user base. Some of the key factors that may lead to fogging include 1) the environment in which the facepiece is stored and used, such as heat, humidity, or moving between hot and cold temperatures, 2) usage conditions such as appropriate donning and worker’s breathing rate, 3) respirator design including facepiece fit, lens, respirator components, and inhalation/exhalation pathways and 4) respirator maintenance and age.

This document serves as a guide to help explain the causes of fogging and help user to determine the best way to mitigate fogging for their situation.

1) Environment
   - Working in extreme heat or cold, moving between hot and cold temperatures or using your facepiece in an environment that is hotter or colder than the facepiece storage environment can all increase the possibility of fogging. Whenever the air temperature inside the lens is different than the temperature of the wearer’s breath, or when the air temperature inside the lens is different than the temperature outside the lens, the chance for fogging will increase.

2) Respirator Usage Conditions
   - Facepieces must fit and be used properly to help mitigate fogging. Facepieces must fit properly to provide appropriate levels of protection. As such, annual fit testing is required. It is important that the wearer then dons and wears the facepiece in the same manner as fit testing was performed. If there are any changes that affect the fit of the facepiece, such as loss of weight, facial hair or PPE, or other conditions, air may leak into the facepiece and exacerbate fogging.
   - High breathing rates are more likely associated with higher levels of fogging. Assuming the wearer is using a facepiece that fits properly; worker breathing rate may affect fogging. As the flow of air in and out of the facepiece increases, fogging may also increase.

3) Respirator Design: Scott facepieces are designed to enable full top-down convertibility for use across multiple respiratory applications. Facepieces are tested along with the rest of respirator components and approved as a complete respirator system by NIOSH (and NFPA/CBRN where applicable). Various components of both the facepiece and the complete respirator can affect fogging.
   - Facepiece lens coating: Scott Safety utilizes a hydrophilic polyurethane polymer anti-fog which allows condensed moisture to spread evenly across the coated surface instead of forming individual droplets appearing as fog.
   - Exhalation path: As designed, exhaled air should pass out of the front of the nosecup, then through the exhalation valve on the adapter (APR).
     1. Nosecup fit on the user’s face may affect the exhalation path and play a role in fogging, for APR users. If the majority of exhaled air is directed out the sides of the nosecup rather than through the exhalation valve, fogging can occur. SCOTT facepieces have nosecup designs that vary slightly by facepiece type and year of manufacturer. When fogging occurs, it may help to try a different size of nosecup so that the majority of air passes through the exhalation valve. To assist users, multiple nosecup sizes are available for most facepieces.
2. Exhaled air may escape from the exhalation path into the facepiece at the point where components attach to the front of the facepiece. The amount of air is minimal and should not cause fogging under normal use. It is important that the user ensure that respirator components are properly attached and not damaged.

- **Adapters / Twin Cartridges:**
  1. Scott adapters vary depending on the filtering unit required by the end user. For Air-Purifying applications using twin cartridges, three adapters have been used historically. The 642 series cartridges used the “T-bar” originally and then were modified to a “V-bar” design for a lower profile. The 742 series cartridges utilize the “Quarter-turn” design. The exhalation path is the same for these adapters while the inhalation path on the 642 adapters was slightly longer. There is no expected difference in fogging due to this difference of the inhalation path.
  2. Twin Cartridges: Scott 642 series cartridges have cylindrical design and Scott 742 series cartridges have an oblong design. Each type is offered either with chemical protection or chemical plus particulate protection. Airflow through the filter is different due to filter shape, and there may be slight difference in inhalation resistance; however, there is no known difference in fogging due to this difference in resistance.
  3. It is possible that different adapters/filter combinations with different facepiece/nosecup combinations may have different overall effects on fogging for different users based on the issues outlined above.

4) Respirator Maintenance and Age
   - **Cleaning:** Scott has tested their facepieces with certain cleaners and disinfecting agents. The user instructions should be followed in order to ensure appropriate use, including washing, rinsing, wiping cloth and drying procedures. Excessive wiping, use of non-approved cleaners, or use of high heat should be avoided due to possible effects on the anti-fog coating.
   - **Inspection:** As with any respirator, regular inspection is required. Be sure to follow all inspection procedures outlined in the Operations & Maintenance manual. In particular as related to fogging, be sure that the facepiece fits properly, the nosecup is seated and located properly, components are attached securely to each other and to the facepiece, and that no parts are damaged.
   - **Age:** Even with appropriate cleaning, through time and use the coating surface will become contaminated from fingerprints, particles in the environment and reactive compounds in the lens. This contamination could diminish the effectiveness of the anti-fog coating. Because facepiece usage and maintenance varies widely among users, it is very difficult, with any accuracy, to predict a specific facepiece or adapter “age” at which the anti-fog coating may become less effective.

Specific SCOTT AV-2000 and AV-3000 facepieces with SureSeal configurations have been tested for and have met very stringent CBRN fogging requirements. While there are specific tests for fogging for CBRN APR applications, there are no specific tests defined by NIOSH to evaluate fogging for industrial full facepiece APR respirators.

With all of the variables outlined above, the exact cause of fogging that may occur differs across individual respirator users. This document serves as a guide for full facepiece industrial APR users to help explain the causes of fogging and help users determine the best way to mitigate fogging for their situation.

Thank you for using Scott Safety products.