



CORROSION INTERCEPT



By Appointment
to Her Majesty Queen Elizabeth II
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Technical Bulletin 28 Corrosion Intercept Photographic Film Preservation

Developed by Bell Labs to solve their various corrosion problems. Intercept is the state of the art in Corrosion protection, providing unequaled and unsurpassed protection.

Static Intercept is a revolutionary technology which uses semi-conductor technology to transform regular plastic into a protective active barrier against corrosive gases, fungus and bacteria. Non Ferrous metals corrode by reacting with corrosive gases such as COS, SO₂, HCl and H₂S. These corrosive gases are formed by such forces as decaying vegetation, burning fossil fuels, from ocean surfaces, as well as many other natural sources. These gases are in every environment, even inside clean Lucent Technologies facilities.

Overview:

To understand how to protect various items you have to begin to understand how these materials are damaged or destroyed. Photographic film protection is an area that is a perfect fit for the Intercept Technology. Photographic Film, developed as well as unexposed, can be attacked and damaged by atmospheric corrosive gases and biological agents. This technical paper will try to provide the data, testing and proof requested to show Intercept's effectiveness in photographic film protection.

Current Method:

Silver Nitrate is one of the active ingredients in photographic film. Silver Nitrate can be easily attacked and chemically altered by reactions with both Sulfur and Chlorine gases (which exist in all environments). The Chemical activity, or the rate of the chemical reactions, of these corrosive gases diminishes at lower ambient temperatures. These corrosive gases migrate quickly through most materials including through foil structures designed to keep out moisture. AT&T determined that even at low levels of Sulfur (approximately 7 ppm) that Beryllium Copper would corrode in as little as 7 days. Silver corrodes much more readily than Copper will. So to extend the shelf life of unexposed film, refrigeration is often used in order to reduce the ambient temperature thus reducing the chemical reactivity.

Refrigeration also slows down biological attack of the film. Bacteria and molds can adversely affect the chemicals as well as the plastic substrate. Even plastic Compact Discs have a shelf life because of bacterial attack. Likewise film is adversely affected by this microbial life. As was the case with chemical activity, biological activity is also slowed by refrigeration, thus extending the shelf life of the photographic film.

Intercept Advantage:

Refrigeration is costly, space limited and restrictive. A more economical way of extending the useful life of film needs to be found. Intercept provides a safe and effective alternative to refrigeration. Due to their relative size and high activity Sulfur and Chlorine can easily penetrate even the most secure container. The only way to ensure that these corrosive gases are kept away from the film is by reacting and neutralizing the gases. Molecular sieves and charcoal papers merely absorb these gases. These absorbed gases can later be released through physical means, or when the paper or sieves are exposed to an increased temperature or humidity level. When the gases are released from the paper or sieves they are now at a higher concentration level, and more deadly.

Intercept does not work by absorbing these corrosive gases, Intercept reacts with them and permanently neutralizes them. Intercept is a Copper based material - with the Copper permanently reacted into the polymer matrix. This Copper backbone gives Intercept its ability to react with and neutralize corrosive gases - both in the atmosphere as well as the gases trapped within the sealed or closed bag, box or tray. Based on testing done at DuPont and AT&T it was determined that under normal levels of atmospheric Sulfur and Chlorine that it would take over 10 years for Sulfur or Chlorine to break through .001" of Intercept film. As the gases attack the surface and try to permeate the bag the active Copper attached to the polymer end chains act as a tortuous path for the gases. It is statistically improbable for any gas to migrate through the plastic without contacting an active corrosion site, being reacted and permanently neutralized.

DuPont Test Data Intercept Technology		
Material	PPM HRS (@640 ppm)	Simulated Exposure at Breakthrough (@1.0 ppm Cl)
LDPE	177 hrs	7.4 days
Intercept LDPE	121,600 hrs	13.8 years
Intercept LDPE	302,720 hrs	34.6 years
Intercept Mylar	251,520 hrs	28.7 years

The testing done at DuPont was repeated on various samples to show repeatability - average values are stated above. It was determined that an average amount of Chlorine in most environments is approximately 1 ppm of Chlorine, which is why that value is reported. It should be noted that Mylar, or Polyester, is a barrier material. However, a Mylar barrier is only as good as its seals - and since Mylar does not seal to itself a Mylar laminate is always needed. A bag made with this type of laminate would normally use a LDPE film, laminated to the Mylar, as the seal layer. The seal area then becomes the point of gas permeation. With the scavenging effects of the Intercept even gas leaking through the seals is stopped. Likewise testing was done at AT&T Bell Labs to determine the permeation of Sulfur. Their results show that under a simulated exposure of 7 ppb of Sulfur (an average level of Sulfur gas in the atmosphere) that it took 10 years to consume .001 inch of

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Intercept film. The test results were verified by SEM analysis of the Sulfated Intercept film. This reactivity of the Copper that keeps the Sulfur from penetrating into the bag also cleanses the air trapped within any Intercept package. The high activity of the Intercept film makes it a preferential corrosion site versus any metallic substance stored within.

Real time aging and accelerated outdoor aging studies have also been set up and monitored over the past 8 years. There has been no failures detected (no corrosion) on the Copper, Silver, Steel, or Silver alloys that have been protected using Intercept bags.

Photographic film is also attacked by biological agents - mildew, mold, and bacteria. It has long been known that Copper is a passive Mildewcide, Fungicide and Bactericide. In the 1800's the government of France started using Copper Carbonate (as a replacement for the more expensive Vertigree or Bordeaux

mixture) to protect their grapes from the ravages of mildew and mold. Copper interferes with the reproduction of these biological systems so within a relatively short time the inside of an Intercept container is free from mildew, fungus and bacteria. The most potent bacteria can only survive 7 days, so without reproduction this strain will die off quickly within Intercept. So, an Intercept container provides excellent biological protection for photographic film and film products.

Conclusions:

Additional data is available upon request. The above information shows that Intercept provides protection from both corrosive gases as well as from microbial attack. Currently Intercept is in test at several highly respected organizations to protect their photographic negatives and prints. Intercept is an effective protection system that can replace traditional refrigeration storage.

Intercept protects against Corrosion Damage:

- Reacts with and permanently neutralizes corrosive gases
- It is the only product available that is effective against Galvanic coupling (the corrosion that occurs when dissimilar metals are joined together)
- Leaves no detectable deposit on any product it protects (unlike VCI's)
- Does not coat - Intercept is completely free from volatile chemicals
- Cleanses trapped air of corrosive gases
- Intercept does not use any silicones or PVC
- Provides cost savings by eliminating secondary packaging or secondary cleaning operations often required with VCI protection or no protection
- Eliminates the need for storage in inert atmospheres or refrigeration
- Environmentally friendly with substantially reduced landfill time (breaking down into Polymer dust) and fully recyclable (meeting tough German recycling laws)
- Effective corrosion protection for the following materials:
- Silver
- Copper
- Bronze
- Tin
- Ferrous Metals (Iron and Steel)

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