STARBRITE®

Vacuum Metallized Pigments for General Industrial Coatings
Color stylist and coatings formulators continually look for new and exciting special effect pigments to deliver novel aesthetics through liquid coatings. Current styling trends in the automotive and consumer goods markets demand the flash and eye-catching appeal of brushed metallic and liquid metal effects. Because this smooth, mirror-like metallic effect cannot be achieved with conventional ball-milled aluminum pigments, STARBRITE Vacuum Metallized Flake (VMF) pigments have become of great interest to coatings formulators.

**STARBRITE Products**

STARBRITE VMF pigments are commercially available in three distinctively reflective grades carried in ethyl acetate (EAC). The first family developed by Silberline is STARBRITE 2100EAC, it has a D(50) of 10-microns and a non-volatile of 10%. This product is recommended for applications requiring high reflectivity and a brushed metal effect. The second family developed was an "ultra" reflective version designated as STARBRITE 4102EAC which has a D(50) of 12-microns and a non-volatile of 10%. Silberline’s latest addition to the STARBRITE VMF family is STARBRITE 5102EAC which, when properly formulated will produce a deeper blue, chrome-like effect with a significantly enhanced DOI versus the previous versions of STARBRITE. Moreover, current studies of STARBRITE 5102EAC in our acrylic-based test formulation have shown it to provide ~20-25% more hiding than the STARBRITE 4102EAC VMF pigment. STARBRITE 5102EAC has a D(50) of 12-microns and a non-volatile of 10%.

If ethyl acetate is not the most compatible solvent with the resin system employed, Silberline offers a variety of alternative solvents upon request. For more information, please contact your Silberline sales representative to inquire about the availability of made-to-order products specific for your application.

### Solventborne STARBRITE Display Formulation

<table>
<thead>
<tr>
<th>STARBRITE 2100EAC</th>
<th>STARBRITE 4102EAC</th>
<th>STARBRITE 5102EAC</th>
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Product Description
STARBRITE Vacuum Metallized Flake (VMF) is a platelet-like aluminum pigment with exceptionally high surface area and aspect ratio. These characteristics allow the formulator to deliver highly reflective, brilliant finishes for the color stylists. STARBRITE VMF pigments are manufactured through a completely unique process, unlike conventionally milled aluminum flakes. With STARBRITE, high purity aluminum metal is physically vapor deposited in a vacuum chamber onto a flexible web that is surface treated with a release coating. The metal is deposited in a dimensionally consistent layer and subsequently removed from the web by dissolving the release coating in a solvent bath. The metal is then appropriately sized, concentrated and packaged for sale. A flow diagram of this process is shown in Figure 1.

The extremely smooth surface characteristics of STARBRITE pigments are evident when compared to conventionally milled aluminum pigments. (See Figure 2) Traditionally ball-milled aluminum pigments come in two varieties: cornflake and round flake. Pigments with cornflake geometry have very irregular surfaces with jagged edges. These properties influence reflected light causing it to diffuse and scatter. Pigments with round flake geometry, commonly referred to as “silver dollars,” are an improvement over cornflake geometry because they possess rounded edges and polished surfaces. However even “silver dollar” flakes contain some surface imperfections and will not impart a mirror-like

![Figure 1 Process Flow](image1)

![Figure 2: Flake Geometries](image2)

![STARBRITE Flake](image3)

![Cornflake](image4)

![Round Flake](image5)
STARBRITE®
Vacuum Metallized Flake (VMF) Pigments

appearance. In contrast, STARBRITE pigments have an extremely smooth surface that produces coatings with the reflectance that mimics a liquid metal effect. The unique attributes of VMF pigments require a non-traditional approach when developing and applying coating formulations. The remainder of this booklet will address specific recommendations for dispersing, storing, formulating and applying STARBRITE VMF pigments for general industrial coating applications.

General Guidelines
Because the EAC solvent used as the carrier for most of the STARBRITE products evaporates at an extremely fast rate, it is advisable to keep STARBRITE products tightly sealed when not in use or while stored. Additionally, while mixing STARBRITE prior to incorporation into a coating system, it would be prudent to keep the mixing vessel covered as much as possible to avoid loss of volatiles.

STARBRITE Dispersion Instructions
STARBRITE is a very low solids product and, as such, is prone to settling. An efficient re-dispersing procedure for this product is to mix it for 10 to 15 minutes with a propeller blade, keeping the material covered as much as possible. An alternate, but effective, method for dispersing this product is to place the sealed container onto a paint shaker for 5-6 minutes of agitation. The material should be homogenous at the end of that time. Note that STARBRITE should be used as soon as is practical, as settling of the aluminum flakes will occur if the product is allowed to sit for extended periods of time.

Formulating Guidelines
STARBRITE VMF pigments behave in ways that are unlike those of conventional milled aluminum flakes and special considerations need to be made when formulating.

Pigment/Binder
Unlike many typical solvent based aluminum masstone systems, STARBRITE VMF formulations are very low in solids content and have extremely high pigment to binder ratios.

The best aesthetics are achieved when STARBRITE VMF pigments are formulated with pigment to binder ratios of as low as 1:1 or as high as 10:1. It is not unusual to have a solvent-based formulation that is less than 4% solids or even as low as 1.5% solids by total weight. A formulation such as this will have an extremely thin viscosity, typically between 8 and 11 seconds in a Zahn 3 cup. This is critical to support proper flake orientation and maximize reflectance.

Solvents
When formulating, try to maintain relatively high levels of fast solvents (generally above evaporation rates of 600-700 compared to Butyl Acetate) and use low levels (about 15% of the
total solvent weight) of the slower tailing diluents. The choice of solvents will depend upon the resin system used and also upon the substrate that you wish to cover. This does not present a problem for coating metal substrates, but should you wish to coat other materials, like plastics or primed metals, you will have to consider the effect that the solvents will have on the materials. Improper solvent combinations can cause marring, hazing, or etching of the surface resulting in severely degraded aesthetics.

Substrates
The substrate must be virtually flawless, as any defect or dirt particle on the surface will be telegraphed through the final coating. It has been found that the smoothest substrate surfaces result in the most chrome-like appearance of the finished coating when using vacuum metallized flake.

A primer/sealer coat may be pre-applied to the substrate to cover any visible surface flaws. However, careful selection of the primer/sealer system, as well as any potential top-coat, should be practiced to avoid interactions of the solvents. Interaction between layers could cause crazing or flake disorientation problems.

Application
Due to the extremely light viscosity inherent in a properly formulated STARBRITE VMF system, ponding, flooding, and runoff are difficult to avoid or control. Systems such as this lend themselves best to automated air assisted siphon spray applications. It is strongly recommended that the operator apply multiple thin coats at low film build for maximum brightness.

A final Dried Film Thickness (DFT) of 0.1 - 0.2 mils will give the best aesthetics. However, a compromise of a higher DFT may be needed to improve intercoat adhesion and chip resistant characteristics.

Clearcoat
If a clearcoat is employed, the basecoat should be fully cured before application of the clearcoat. This reduces the chance of solvent "strike in" between the basecoat and the clearcoat that could cause disruption of flake orientation and detract from brightness and chrome-like appearance of the final coating.
Starting Point Formulations and Application Guidelines

First Side Formulation on Black ABS Plastic

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<th>Panel 1</th>
<th>Panel 2</th>
<th>Panel 3</th>
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<td>STARBRITE 5102 EAC</td>
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</tr>
<tr>
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<td>1.00</td>
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<tr>
<td>TBAc</td>
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First and Second Side Clear PMMA Plastic Formulation

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Mixing Instructions:
First charge the container with DIBK, TBAc and Paraloid B-84 resin. Stir at low speed with a propeller blade for approximately 5-10 minutes until thoroughly dispersed. Add the STARBRITE under gentle agitation and continue to mix for an additional 5-10 minutes until thoroughly dispersed. Paraloid B-67 can be substituted for Paraloid B-84 in the above formulations.

Storage Considerations
The ethyl acetate solvent used as a carrier for STARBRITE VMF pigments evaporates at an extremely high rate. Therefore, precautions should be taken when working with STARBRITE.
VMF pigments to minimize this evaporation. Common practices such as keeping materials tightly sealed when not in use, minimizing exposure to high temperatures, and storing the product in cool, dry locations are recommended.

Due to the ethyl acetate solvent, STARBRITE 2100EAC, STARBRITE 4102EAC and STARBRITE 5102EAC are classified as a flammable liquid. All of these products should be handled and stored in accordance with the requirements of The National Fire Protection Association (NFPA) 30, "Flammable and Combustible Liquids Code."

Suppliers of Suggested Raw Materials

Paraloid B-84
Univar
Middletown, PA
1-717-944-7471

Tert-Butyl Acetate (TBAc)
Brenntag
Reading, PA
1-888-926-4151

Di-Isobutyl Ketone (DIBK)
Brenntag
Reading, PA
1-888-926-4151

Methyl Ethyl Ketone (MEK)
Brenntag
Reading, PA
1-888-926-4151