Sterling Colour 210 Series is based on a unique thermoset resin matrix, offering improved resistance properties compared to conventional thermoset fluorescent products. The high colour strength makes it economical to use and the very small spherical shaped particles ensure easy dispersion. It is particularly recommended for paint and ink applications where solvent attack may be a problem or in PVC where dye migration occurs with other types of pigments. It is also recommended for some plastics applications, because of its resistance to plate-out.

Applications
Sterling Colour 210 Series is recommended for a variety of coatings and plastics applications including:

- Paper Coating
- Aqueous Latex Paints
- Alkyd Paints
- Acrylic Paints
- Polyurethane Paints
- Non-convertible coatings based on both aliphatic & aromatic solvents
- Cellulose Paints
- Rubber-based Coatings
- Water Colours
- Aerosols
- PVC
- Natural and Synthetic Rubbers
- Calendered Fabrics
- Spread Coated Fabrics

Sterling Colour 210 Series is particularly recommended where resistance to strong polar solvents such as ketones, esters, ethers and alcohols or heat are required. 210 Series is also recommended for water based latex systems for improved shelf life.

A high clarity vehicle or binder system of a light colour and with good wetting properties will give the maximum brightness.

Light-fastness
Daylight fluorescent pigmented coatings are stable almost indefinitely under artificial indoor light, and indirect sunlight itself has little or no effect. Direct sunlight, however, frequently causes an initial darkening, followed by a gradual lightening of shade. This is due to the ultraviolet portion of sunlight that will degrade daylight fluorescent coatings on prolonged exposure.
To optimize stability, it is recommended that formulations that are used for outdoor applications contain a higher percentage of Sterling Colour 210 Series fluorescent pigment as this will possess higher light-fastness ratings than similar lower pigmented formulations.

Light-fastness is assessed in a Xenotest apparatus and results are tabulated against the Blue Wool Scale (BWS) which ranges from 1-8. Once exposed, any fading apparent on the test is compared to a control.

It must be emphasized that the light-fastness rating can be valid only for the particular application and formulation from which the light-fastness rating quoted was obtained. It is not possible to ascribe a light-fastness rating to a pigment alone, but only to a particular concentration of pigment in a specified medium at a given coating thickness.

To obtain maximum light-fastness, apply as thick a coating as possible with the highest technically feasible level of pigmentation. A pigment volume concentration of at least 50% will give the best results.

During application, two thick coats of paint are recommended, each a minimum of 50 microns dft of fluorescent paint over a suitable white undercoat. For improved light-fastness apply a clear protective top coat incorporating a suitable UV absorber. The use of UV absorber may reduce the fluorescent effect so its level needs to be optimized. The use of acrylic, certain two pack polyurethane and alkyd systems offer more UV protection than non-convertible systems.

**Solvent-resistance**

210 Series has very good solvent resistance compared with many other fluorescent pigments making it suitable for a wide range of coatings applications where aromatic or oxygenated solvents are needed.

![Solvent-resistance chart](image)

**Formulating**

The use of activated Bentonite or other suitable thixotropic agent reduces settling which may occur in fluorescent paints.

Non-opaque white extenders or fillers, such as calcium carbonate may be used in small quantities without serious effect on brightness or colour. Opacifiers are not normally recommended, as they will produce a pastel shade and may quench the fluorescent effect.
Dispersion
Disperse with high-speed (Cowles) mixers. Milling or grinding is not normally required and may destroy the microspherical particles. Though Sterling Colour 210 Series has good solvent resistance prolonged processing in systems with a high proportion of toluene or oxygenated solvents should not exceed 30°C.

Particle Size Distribution
The unique way in which 210 Series is made provides a narrow particle size distribution of very small spherical shaped particles. These microspheres ensure easy dispersion and uniform colour.

Undercoat
Daylight fluorescent colours are translucent, not opaque, therefore fluorescent coatings should be applied over a white undercoat or diffuse white surface in order to obtain the maximum daylight fluorescent effect.

Cleanliness
All processing equipment must be extremely clean as even small quantities of non-fluorescent material can contaminate and reduce brightness and fluorescent effect.

General Guidelines
A white base coat followed by the fluorescent coating gives the best results.
Although the pigment is insoluble in most solvent and plasticizer systems, it is possible for migration of the microspherical particles or colour bleed to occur in certain conditions. Bleed is more noticeable with pink, violet and magenta shades and trials with the proposed system prior to manufacture are recommended.
Pre-production testing is particularly important where polyurethane-based coatings are planned as 210 Series may contain small residual quantities of water.

![Particle Size Distribution Diagram](image)
PVC Spread Coating

Sterling Colour 210 Series is especially recommended for PVC spread coating applications, offering excellent bleed and migration resistance when used with plasticizers and solvents.

Formulation for PVC Spread Coating applied by the doctor knife technique. The coated fabric should be cured by either steam or infrared at a temperature between 130°C and 180°C depending upon the polymer used.

<table>
<thead>
<tr>
<th>Component</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vinnolet 1 P70</td>
<td>56.4</td>
</tr>
<tr>
<td>210 Series</td>
<td>9.7</td>
</tr>
<tr>
<td>Dioctyl Phthalate</td>
<td>15.6</td>
</tr>
<tr>
<td>Lankroflex 2 ED6</td>
<td>8.6</td>
</tr>
<tr>
<td>Dioctyl adipate</td>
<td>6.5</td>
</tr>
<tr>
<td>Organic zinc stabiliser</td>
<td>3.2</td>
</tr>
<tr>
<td></td>
<td>100.0</td>
</tr>
</tbody>
</table>

1. Vinnolit
2. Akros

Stabilisers

The correct choice of heat and light stabilisers is very important. Stabilisers used in the plastisol system must first be checked to establish their compatibility.
Inks

Applications
Sterling Colour 210 Series is recommended for a variety of ink applications as illustrated in the table:

<table>
<thead>
<tr>
<th>Application</th>
<th>Screen Process</th>
<th>Flexographic</th>
<th>Gravure</th>
<th>Textile</th>
</tr>
</thead>
<tbody>
<tr>
<td>STANDARD</td>
<td>Aliphatic &amp; Aromatic solvents only ▲</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Water-based ▲</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOW COST</td>
<td>Aliphatic &amp; aromatic solvents only ▲</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MISCELLANEOUS</td>
<td>Vinyl &amp; other plastics</td>
<td>UV curable</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flexographic</td>
<td>Solvent Based ▲</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Water Based ▼</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gravure</td>
<td>A type ▼</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C type ▼</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Water Based ▼</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Textile</td>
<td>General Purpose ▼</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Crock &amp; Dry Clean resistant ▼</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

■ = Series Recommended
▲ = May be used for selected applications

There are many types of screen printing ink systems designed and formulated to print onto a varied selection of substrates with differing end uses.

Sterling Colour 210 Series fluorescent pigment is suitable for use in the vast majority of formulations. The pigment series selection is dependent upon the solvent system used in the ink formulation and the end use application.

Daylight fluorescent colours are translucent and so best results are obtained by printing on to an opaque white surface. The light-fastness properties of fluorescent inks are limited and therefore they are not generally recommended for long term outdoor exposure.

Textile Printing Inks
Sterling Colour 210 Series is recommended for use in water-based textile printing inks, applied by screen process on flat bed and rotary machines. It offers improved crock resistance and dry clean resistance properties. On well formulated fluorescent inks using 210 Series, wash and dry cleaning results of level 5 (maximum) on the AATCC Scale are possible.
Starting Point Formulation

<table>
<thead>
<tr>
<th>Component</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>210 Series</td>
<td>35.0</td>
</tr>
<tr>
<td>PVC homopolymer (high visc.)</td>
<td>30.0</td>
</tr>
<tr>
<td>Plasticizer</td>
<td>24.5</td>
</tr>
<tr>
<td>Low opacity extender/filler</td>
<td>10.0</td>
</tr>
<tr>
<td>Metal salt stabilizer</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td>100.0</td>
</tr>
</tbody>
</table>

For best results, apply through a 49-77T polyester mesh

Plastics & Rubber

Applications
Sterling Colour 210 Series is recommended for a variety of plastics and rubber applications including:
- Masterbatch
- Mouldings & Extrusions
- Blow Mouldings
- Liquid Colorants
- Vinyl Plastisols
- Vinyl Calendered Film
- Powder Coatings

and is recommended in these polymer systems:
- Low density polyethylene
- High density polyethylene
- Polypropylene
- General purpose polystyrene
- High Impact polystyrene
- PVC calendering
- PVC spread coat
- Natural and synthetic rubbers

Sterling Colour 210 Series is a thermoset grade with very uniform particle size which allows for easy dispersion. It contains very low levels of monomer and exhibits negligible plate-out. It is suitable only up to 220°C

Processing in Plastics and Rubbers
Fluorescent colours are much brighter than conventional non-fluorescent colours, and are particularly good in plastic applications where a brilliant effect is required. The final colour and opacity is dependent upon the polymer and good colour in those with minimal opacity such as polyethylene and polypropylene.

Crystal polystyrene also gives good results with a transparent effect and excellent edge glow. Polymers containing additives such as the non-shrink or nucleated grades of polypropylene can cause shade variability with fluorescent pigments. The fluorescent effect is also lessened using filled grades of plastics compared with pure polymers. Higher opacity resins such as high impact polystyrene tend to reduce the fluorescent effect and greater concentrations of fluorescent colour are needed.
210 Series has also found to be effective in EVA, PU and other types of synthetic and natural rubbers. Though the 210 Series has been found to have good resistance to the catalysts, accelerators and curing agents commonly used in the rubber industry, combinations of certain sulphur and/or organic peroxides can cause colour shift problems and it is recommended that these be evaluated thoroughly prior to commercial production runs in order to minimize any effects.

Opacity can sometimes be improved by small additions of rutile grade titanium dioxide but this is not always necessary with 210 series because of the opacity provided by its unique microspheres. The fluorescent colour will become more pastel as the quantity of titanium dioxide is increased and fluorescence may be quenched. Similarly opaque non-fluorescent toners of a similar hue to the fluorescent colour will also improve opacity but as the quantity of such toners is increased the fluorescent brightness will diminish.

Extenders / fillers can be used to aid processing and to adjust the physical properties of the material but the fluorescent effect will be reduced as the quantity is increased so that fluorescence will become weak and washed out. Their use should be minimised to enable good colour development.

To obtain maximum colour and brightness it is important to use sufficient pigment. The quantity used will be dependent upon the thickness of the moulded product, as illustrated in the table.

<table>
<thead>
<tr>
<th>Thickness</th>
<th>210 Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.25 mm</td>
<td>3 - 4%</td>
</tr>
<tr>
<td>0.50 mm</td>
<td>2 - 2.5%</td>
</tr>
<tr>
<td>1.00 mm +</td>
<td>0.5 - 1.7%</td>
</tr>
</tbody>
</table>

Additives used in masterbatch and polymer production may have adverse effects. This is particularly true of organo-metallic compounds. Undesirable effects can vary from shade to shade so it is essential that each colour is evaluated in before going into full scale production.

Sterling Colour 210 Series has good light stability indoors away from direct sunlight.

In direct sunlight fluorescent colours will fade because the conversion of energy which produces the fluorescent effect causes a degradation of the molecular structure. The fastness to sunlight is not as good as many non-fluorescent colorants.

Increasing the quantity of fluorescent pigment will increase light-fastness, but a certain point can be reached when the fluorescent pigment may adversely affect the physical properties of the polymer.

Light-fast non-fluorescent colours of a similar hue to the fluorescent colour can be used to give a residual colour as the fluorescent colour fades. As the quantity of non-fluorescent colour is increased so the fluorescent brightness will be reduced.

Optimum light stability and brightness are obtained with good dispersion, lower temperatures and short dwell times. Once fluorescent articles have been exposed to heat they will degrade faster on reheating. When the decomposition point of the fluorescent pigment is approached there is a deterioration of the colour value. These factors should also be considered where recycling of the pigmented polymer is planned.

The maximum processing temperature for Sterling Colour 210 Series is 220°C but only 200°C for Violet.

**Dispersion**

Sterling Colour 210 Series can be dispersed with a Banbury mixer or twin screw extruders. Poor colour is generally the result of inadequate dispersion. The addition of a wetting agent such as a light grade of mineral oil or butoxy ethyl stearate at 0.1 % based on polymer weight improves the adhesion of the pigment to the polymer during dry tumbling, resulting in better dispersion and colour strength.

**Masterbatch Production**

Sterling Colour 210 Series may be used as toners to brighten the colours of non-fluorescent masterbatch.
**Plate Out**
Sterling Colour 210 Series is particularly recommended for its resistance to plate out. However, its lower temperature stability (maximum processing temperature 220°C) means that it cannot be used in every application.

**PVC Plastisols: Moulded and Calendered**
Sterling Colour 210 Series offers significantly better migration resistance and improved heat stability over conventional fluorescent pigments in these applications. Where bleed resistance is important then it shows improved performance over other thermoset products.

**Starting Point Formulation: PVC Plastisol for Calendering and Fabric Coating**

<table>
<thead>
<tr>
<th>Component</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>PVC Latex</td>
<td>57.1</td>
</tr>
<tr>
<td>Dioctyl Adipate</td>
<td>6.5</td>
</tr>
<tr>
<td>Dioctyl Phthalate</td>
<td>15.8</td>
</tr>
<tr>
<td>Epoxidised Octyl Stearate</td>
<td>8.7</td>
</tr>
<tr>
<td>Barium/Zinc Stabiliser</td>
<td>3.2</td>
</tr>
<tr>
<td>210 Series</td>
<td>8.7</td>
</tr>
</tbody>
</table>

100.0

Gel @ 150°C.

The recommended loading of Sterling Colour 210 Series depends on the thickness of the film as illustrated in the table:

<table>
<thead>
<tr>
<th>Thickness</th>
<th>210 Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.13mm</td>
<td>7 – 10%</td>
</tr>
<tr>
<td>0.25mm</td>
<td>4 - 7%</td>
</tr>
<tr>
<td>0.50mm</td>
<td>2 - 4%</td>
</tr>
<tr>
<td>1.00mm +</td>
<td>0.5 - 2%</td>
</tr>
</tbody>
</table>

**Health, Safety and Other Information**

**Safety Data Sheets**
Individual Safety Data Sheets prepared in accordance with Regulation (EC) No. 1907/2006 (REACH) are available for each shade in the 210 Series range. Please request these from your distributor or our customer services’ department.

The remainder of this section gives details on the relevant health and safety considerations for 210 Series. These data are given without warranty and are provided for the guidance of customers and formulators. Sterling Colour has no control over the formulation, processing or end use of its pigments so end users need to assess the compliance of the final product with any regulations or legislation.

Individual declarations relating to RoHS, SoVHC, Phthalates, Bisphenol A and a variety of other chemicals are too numerous to include here but are available on request through your distributor or from the customer services’ team.
REACH
Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) has been introduced to control the manufacture and import of chemicals in the EU.
Sterling Colour 210 Series consists of a mixture of chemicals and as such cannot be registered under REACH. However all substances used in the manufacture of the products including those monomers used to manufacture the polymers which form part of the preparations have been pre-registered.
Sterling Colour and its suppliers will continue to support the products through the REACH process.

ISO9001:2008
Sterling Colour has been approved to the ISO 9000 international quality standard since 1992.
Sterling Colour’s current registration is to ISO9001:2008 and ensures that our systems and standards covering products and service are externally audited on a regular basis.
As a company, we are dedicated to bringing all of our customers the highest level of support, both today and in the future.

Toy Safety - EN71-3 Metals (“Heavy Metals”)
An Independent UKAS Laboratory (registration number 0947) has tested samples representative of our products according to the methods prescribed in EN71-3: Safety of Toys 1995, which specifies the migration of certain elements. Their tests confirm the following levels of those elements:

<table>
<thead>
<tr>
<th></th>
<th>Antimony</th>
<th>Arsenic</th>
<th>Barium</th>
<th>Cadmium</th>
<th>Chromium</th>
<th>Lead</th>
<th>Mercury</th>
<th>Selenium</th>
</tr>
</thead>
<tbody>
<tr>
<td>210 Series</td>
<td>&lt;5</td>
<td>&lt;10</td>
<td>&lt;20</td>
<td>&lt;5</td>
<td>&lt;5</td>
<td>&lt;5</td>
<td>&lt;5</td>
<td>&lt;5</td>
</tr>
<tr>
<td>EN71-3 Limit</td>
<td>60</td>
<td>25</td>
<td>1000</td>
<td>75</td>
<td>60</td>
<td>90</td>
<td>60</td>
<td>500</td>
</tr>
</tbody>
</table>

Toy Safety - EN71-9 Formaldehyde
The standard EN71-9 Safety of Toys – Part 9: Organic Chemical Compounds specifies requirements for the migration or content of certain hazardous organic chemical compounds from or in certain toy materials by differing exposure routes. With the exception of formaldehyde, none of the organic compounds listed in this standard are present in Sterling Colour 210 Series:

Flame retardants (Table 2A) | Solvents (migration) (Table 2E),
Colorants (Table 2B) | Solvents (inhalation) (Table 2F),
Primary aromatic amines (Table 2C) | Wood preservatives (Table 2G),
Monomers* (migration) (Table 2D) | Plasticizers (Table 2I)

*except formaldehyde

An Independent UKAS Laboratory (registration number 0947) has tested samples representative of 210 Series products according to the methods prescribed in EN71-9 and has shown formaldehyde migration to be less than 15 mg/litre.
EN71-9 lists formaldehyde under Monomers (Table 2D) with a migration limit of 2.5 mg/litre.
As the amount exceeds the limit in Table 2D we cannot declare compliance for these products to EN71-9. However, when used as recommended it is quite possible that in the final application, (depending upon the pigmentation level) formaldehyde migration will be less than the 2.5 mg/litre limit.
We would suggest that the final product is analysed for formaldehyde migration to show compliance with this standard.
FDA Approval
Daylight fluorescent pigments are not recommended for use as food additives or for direct food contact. No approvals have been sought with the American Food and Drug Administration (FDA).

Colour Index Numbers
Daylight fluorescent pigments are not classified under the Colour Index system because they are made from a combination of dyes in a resin matrix, and do not qualify as ‘pigments’ according to the Society of Dyers and Colourists.

CAS Numbers
210 Series fluorescent pigments are not assigned with individual CAS Numbers. However, the raw materials and polymers that we use in the manufacture of our products in this brochure have CAS Numbers.
Providing the list of CAS numbers for any one product amounts to disclosure of proprietary formulation information which is commercially sensitive and as a result, is not available for general circulation outside our company.
Sterling Colour will disclose more detailed information on composition directly to government agencies and other competent regulatory bodies. Similar information may be disclosed to Regulatory Affairs Professionals within customer, agency and commercial organisations only under the terms of a secrecy agreement.

Sterling Colour is one of the world’s leading manufacturers of Daylight Fluorescent colours with a comprehensive range of products suitable for most applications. This leaflet introduces 210 Series.

Other series are available for use in inks, paints, coatings, plastics and many other applications.

Please contact us, or your local distributor for further details.

The Sterling Colour guarantee is limited to the consistent quality of its products. Technical information, advice, verbal and written suggestions and test results are offered for guidance without responsibility. No warranty of merchantability for a particular purpose is made. Users are responsible for testing our products and suggestions to ensure that they are suitable for the intended purpose and application prior to use.

7 Stanley Street Stalybridge Cheshire SK15 1SS United Kingdom
Tel: +44 (0)161 304 4020 Fax: +44 (0)161 303 9007 www.sterling-colour.co.uk

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