3M™ Screen Printing Ink Series 1900 four color and Screen Print Clear VI0402

Product Description
- Fast drying opaque inks
- Available in line ink and four color inks
- Weather resistant
- Excellent color retention
- Superior exterior performance on difficult application surfaces, including corrugated and riveted surfaces.
- Metallic flakes may be added to line color inks
- Lead-free materials are available

What is Four Color Screen Printing
Four color screen printing is the reproduction of a full color original subject as a halftone. The three primary colors—yellow, magenta, and cyan—plus black are printed sequentially in close register to form the image.

The processing of four color screen printed graphics requires careful preparation and execution. Be aware that the pigments in 3M™ Screen Printing Ink Series 1900 may be slightly different than those in other 3M four color screen printing inks. Adjustments may need to be made in the color separations when switching from one ink to another.

Product Line
Half Tone Concentrates and Bases

<table>
<thead>
<tr>
<th>Half Tone Concentrates</th>
<th>Half Tone Bases</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990 Yellow</td>
<td>1997 Standard</td>
</tr>
<tr>
<td>1991 Magenta</td>
<td>1998 Retarder</td>
</tr>
<tr>
<td>1995 Black</td>
<td></td>
</tr>
<tr>
<td>1996 Cyan</td>
<td></td>
</tr>
</tbody>
</table>

1. Concentrates are lead-free

Screen Print Clears

<table>
<thead>
<tr>
<th>Liquid Clear Coats</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1920DR</td>
<td>Dirt Resistant Screen Print Clear</td>
</tr>
<tr>
<td>1930</td>
<td>Matte Screen Print Clear</td>
</tr>
<tr>
<td>VI0402</td>
<td>Petroleum Resistant Clear</td>
</tr>
</tbody>
</table>

2. For graphics used where frequent petroleum spills occur, we recommend using clear VI0402.

Toner/Reducer

<table>
<thead>
<tr>
<th>Toner/Reducer</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1910</td>
<td>Gloss Toner/Reducer</td>
</tr>
</tbody>
</table>
3M™ Thinners

<table>
<thead>
<tr>
<th>For Inks or Concentrates</th>
<th>For Clears</th>
</tr>
</thead>
<tbody>
<tr>
<td>CGS-30</td>
<td>CGS-30</td>
</tr>
<tr>
<td>CGS-50</td>
<td>CGS-50</td>
</tr>
<tr>
<td>CGS-80</td>
<td></td>
</tr>
</tbody>
</table>

NOTE: The higher the CGS number, the slower the evaporation rate.

Warranty and Durability

For complete details on durability and warranty, please refer to the base film’s 3M Product Bulletin.

Health and Safety

⚠️ CAUTION ⚠️

When handling any chemical products, read the manufacturers’ container labels and the Safety Data Sheets (SDS) for important health, safety and environmental information. To obtain SDS sheets for 3M products go to 3M.com/SDS, or by mail or in case of an emergency, call 1-800-364-3577 or 1-651-737-6501.

When using any equipment, always follow the manufacturers’ instructions for safe operation.

Ventilation

Provide local and/or general exhaust ventilation in the print production areas to prevent a build up of ink vapors and to maintain levels below the limit for worker exposure. An experienced industrial ventilation engineer and/or a certified industrial hygienist can help evaluate your ventilation requirements and design based on your onsite process conditions.

Please refer to the printer manufacturer’s literature for additional details and requirements.

Air Quality Regulations

State Volatile Organic Compound (VOC) regulations may prohibit the use of certain chemicals with VOC’s in graphic arts coatings and printing operations. For example, the California South Coast Air Quality Management District prohibits use of certain solvent-based solutions without a permit and other California AQMD’s prohibit use of certain solutions without a permit or regulatory exemption. Check with your State environmental authorities to determine whether use of this solution may be restricted or prohibited.

More on Environmental Health and Safety

Additional environmental, health, and safety information is available on our website at 3Mgraphics.com/sustainability.

Sheet Preparation

Sheet Conditioning

You may need to condition the sheets of film before using them for a job that has tight tolerances or multiple colors. A change in the humidity or the temperature can affect the moisture content of the liner during storage and/or printing. These changes can affect registration and lay-flat characteristics.

Some screen printers find it helpful to run the unprinted sheets through the conveyor dryer once immediately before printing.

For the best result, follow these guidelines:
All Liners

- Keep the sheets of the film wrapped in polyethylene.
- Complete the printing as quickly as possible.
- Avoid stacking the sheets of film in an uncontrolled environment. The stacked sheets absorb moisture unevenly and may develop wavy edges.

Kraft Paper Liner Only

- Stabilize the sheets under the normal humidity and temperature conditions of the shop.
- Condition the sheets overnight by racking them individually or two sheets face-to-face.

Liner Printing

- Polyethylene-coated paper liners cannot be printed.
- Kraft paper liner can be screen printed before printing the film. Use a fast drying lacquer or a fast drying halftone black screen printing ink for paper.
- Methods for printing liners:
  - Screen printing: use a fast drying screen printing ink for paper. Rack the sheets individually until they are dry—at least 30 minutes.
  - Printing on a press: use a fast-drying, black halftone ink. Stack the sheets.

Note: Make sure the ink used on the liner does not transfer to the film or ink series 1900 later during processing. Slip sheeting may be necessary.

Sheet Cutting

The sheet size and the direction the sheet is cut from the roll can affect the liner stability to humidity and temperature variations.

For the best results, follow these guidelines:

- Print a fewer number of graphics on a smaller sheet size instead of printing more graphics on a larger sheet.
- If possible, cut all sheets in the same direction and put the critical length parallel to the roll edge.

Scotchlite Reflective Graphic Film

3M™ Scotchlite™ Transparent Screen Printing Ink Series 2900, which is transparent ink, is the recommended ink to use. Ink Series 1900 can be used but most of the inks are opaque, will not transmit light and will appear black at night.

2900 ink series can be used with clear 1920DR.

Ink Coverage

Many factors affect the ink coverage, including:

- Screen mesh and type
- Average halftone dot density
- Amount of thinner
- Hardness (durometer) and angle of the squeegee

Four Color Inks

Under typical conditions with press-ready ink and using a 280 tpi (threads per inch) mesh screen the approximate coverage is:

- Solid (100%) printing: one gallon per 1800 square feet (3.8 liters per 44 square meters).
- 50% dot coverage: one gallon per 3600 square feet (3.8 liter per 88 square meters).
Maximum Ink Coverage

Ink coverage on the finished graphics (excluding clear coat) must not exceed 280%. This can be done by the color separator using gray component replacement (GCR) or another similar technique. If more than 280% ink coverage is used, the finished graphics may have unacceptable flexibility after application.

Screen Print Clear 1920DR and 1930

Under typical conditions with press-ready clear and using a 200 tpi mesh screen, the approximate coverage is one gallon per 2500 square feet (3.8 liters per 61 square meters).

Screen Print Clear VI0402

Under typical conditions with press-ready clear and using a 230 tpi mesh screen, the approximate coverage is one gallon per 2500-3000 square feet (3.8 liters per 61 square meters).

Mixing

IMPORTANT NOTE

Never mix half-tone ink series 1900 with any other ink series. Doing so voids the warranty.

Mix the inks and clear for 10 minutes when formulating or thinning. This ensures an even distribution of all ink components.

Use a high-speed power mixer with a blade 1/3 to 1/2 the diameter of the container. If the blade is smaller than this, move it around in the container. Put the blade 2/3 of the way into the liquid.

A paint shaker may also be used with metal cans.

Formulating Inks

Always thoroughly mix the ink components as described in "Mixing" on page 4 and test the formulation for printability.

Thinning

Four Color Inks

Always mix the ink components as described in "Mixing" on page 4.

• Four color ink series 1900 are supplied as concentrates.
  The recommended formula by weight is:
  - 20% ink concentrate
  - 70% halftone base
  - 10% thinner

• Up to 10% more CGS-30, CGS-50 or CGS-80 may be added to reduce the viscosity. The higher numbered solvents have slower evaporation rates.

• Excessive drying in the screen may require a higher proportion of retarder halftone base 1998 and/or thinner CGS-80. Use caution when making these adjustments as slow drying problems may result as the system is retarded.

• Always mix enough ink for the entire job in one batch. Even the most careful weighing and mixing usually does not produce two lots of the same color that print at the same density. Density shifts affect the gray balance.

• Except as specified in this Instruction Bulletin, we do not recommend or warrant the following:
  - Printing four color ink series 1900 at strengths reduced beyond our recommendations.
  - Using color formulations for line copy.
  - Modifying color hue.
Screen Print Clear 1920DR and 1930

Always mix the ink components as described in "Mixing" on page 4.

- To thin a clear for screen printing:
  - Use thinner CGS-30 or CGS-50.
  - Start by adding one part thinner to 5 parts clear by volume.
  - The recommended viscosity is 600 to 700 centipoise (approximately 30 seconds in a #5 Zahn cup).

- To thin a clear for roller coating:
  - Thin the clear no more than 30% by weight.

- Clear 1920DR and 1930 can be mixed to obtain a custom gloss. However, adding clear 1930 to clear 1920DR reduces the durability of clear 1920DR. The warranty is the same as for the least durable component. Mixing clears is not warranted on top of digital inks.

Screen Print Clear VI0402

Always mix the ink components as described in "Mixing" on page 4.

- To thin clear VI0402:
  - Use thinner CGS-80.
  - Start by adding one part thinner to 5 parts clear by volume.
  - The recommended viscosity is 600 to 700 centipoise (approximately 30 seconds in a #5 Zahn cup).

Screen Print Clear 9740i

Clear 9740i can be printed on top of ink series 1900; however, ink series 1900 must be completely dried. Any remaining solvent causes the surface of the clear coat to be cloudy. See the appropriate 3M Product and Instruction Bulletins for printing recommendations and coverage.

Color Control Tools

Producing a large quantity of multi-sheet, four color graphics requires a high degree of color control. Visual judgment of color and density are not satisfactory. Listed below are two quality control tools that are essential for a high yield of quality graphics.

1. A satisfactory proof or acceptable color progressive of the same graphic retained from a previous printing with the same inks. In either case, the color bars must be present for solid tone and half tone measurements.

2. A reflection densitometer equipped with color filters identified as “separation” or “graphic arts” filters (narrow band). Color filters identified as Status A, M, T or SPI are not acceptable.

Color Density Targets

A measurement of the color density of the first color-bar of the proof serves as the target density for printing the first color. This measurement can be made on either of the items in Step 1 in "Color Control Tools" on page 5. If either of these is not available, the density that one obtains for a graphic will depend on the model of densitometer used and its condition from length of use, age of bulb in densitometer, age and condition of filters, and so on. Density readings should not be quoted and transferred from one densitometer to another. Printed color bars, either litho or screen printed, should be used for reference.

The following table provides examples of some densities of the YMCK that one might obtain.

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**IMPORTANT NOTE**

Prior to measuring the densities of the proof, make sure the densitometer has been zeroed to the white of the substrate before measuring the densities of the printed ink series 1900.

<table>
<thead>
<tr>
<th>Color</th>
<th>Suggested Target Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow (Y)</td>
<td>1.00</td>
</tr>
<tr>
<td>Magenta (M)</td>
<td>1.30</td>
</tr>
<tr>
<td>Cyan (C)</td>
<td>1.30</td>
</tr>
<tr>
<td>Black (K)</td>
<td>1.50</td>
</tr>
</tbody>
</table>

**Color Control**

**First Color**

One good screening conditions have been established, the density of a color bar should be measured and compared to the target value. If this density differs from the target by more than 0.03, the inks will need to be adjusted. For other than mechanical adjustments, refer to the following table for guidance.

**Other Colors**

The commitment to a density for the first color establishes the density targets for the subsequent colors. Each of the original target densities should be adjusted by an amount equal to the difference between the first color and its target.

The table below provides an example of the difference between original and new target densities when using multiple colors. Every attempt should be made to screen to densities within 0.05 of these targets.

As printing progresses, the densities of the color bars and selected areas of halftone dots should be monitored. Any change in the densities indicates a potential problem that should be addressed before a density drifts out of an acceptable range.

<table>
<thead>
<tr>
<th>Color</th>
<th>Target</th>
<th>Actual</th>
<th>Difference</th>
<th>New Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow (Y)</td>
<td>1.00</td>
<td>0.91</td>
<td>-0.09</td>
<td>1.21</td>
</tr>
<tr>
<td>Magenta (M)</td>
<td>1.30</td>
<td></td>
<td>-0.09</td>
<td>1.41</td>
</tr>
<tr>
<td>Cyan (C)</td>
<td>1.30</td>
<td></td>
<td>-0.09</td>
<td>1.41</td>
</tr>
<tr>
<td>Black (K)</td>
<td>1.50</td>
<td></td>
<td>-0.09</td>
<td>1.41</td>
</tr>
</tbody>
</table>

**Ink Adjustment - Density**

It it is necessary to increase or decrease the printing density of the ink as originally mixed, the following table may be used to estimate the quantities of ink concentrate or halftone base and thinner which must be added to effect the desired result.

<table>
<thead>
<tr>
<th>Desired Density Change</th>
<th>Percentage of Original to Add</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.05</td>
<td>12%</td>
</tr>
<tr>
<td>0.10</td>
<td>26%</td>
</tr>
<tr>
<td>0.15</td>
<td>41%</td>
</tr>
<tr>
<td>0.20</td>
<td>58%</td>
</tr>
<tr>
<td>0.25</td>
<td>78%</td>
</tr>
<tr>
<td>0.30</td>
<td>100%</td>
</tr>
</tbody>
</table>
Thus to increase the density by 0.15, add 41% of the original weight of ink concentrate. To decrease a density by 0.10, add 26% of the original weight of halftone base and thinner, but do not exceed the recommended densities.

If you add components to adjust the density or printability, mix for an additional 5 minutes.

**IMPORTANT NOTE**

If the ink has been reclaimed from the screen, original weights must be reduced based on the reclaimed weight before the additions are calculated.

**Screen Printing**

The printing order of the colors is not critical but should be the same as the order used in proofing.

The following procedures and recommendations assume the availability of a satisfactory halftone positive. If guidance is needed in obtaining satisfactory positive, contact 3M Technical Service.

**Frame**

- Use a rigid, metal frame.
- Include a 6 to 10 inch (15 to 25 cm) well between the frame and the graphic design on all sides.
- The recommended screen tension is 20 newtons/cm or higher.

**Fabric**

Tightly and uniformly stretch a monofilament thread, twill or plan weave fabric on the frame. Using a plain weave or calendered fabric may reduce the color intensity and opacity.

- **Four Color inks**: Use a 280 tpi screen fabric.
- **Clear 1920DR and 1930**: Use a 200 tpi screen fabric.
- **Clear VI0402**: Use a 230 tpi screen fabric.

**Stencil**

- Use a stencil that is water soluble and resistant to ketones and strong lacquer solvents.
- Prepare all stencils for a graphic before printing begins.

**Squeegee**

- Use a sharp squeegee with a medium to hard, rubber or plastic blade. The squeegee should be large enough to overlap the design by at least 2 inches (5 cm) on each side.

**Screen Exposure**

- Expose screens in a vacuum frame with the exposure lamp separated from the screen plan by a distance greater than the diagonal dimension of the area to be exposed.
- Monitor each exposure by including a transparent gray scale and controlling it with an exposure integrator.
- Maintain tight, uniform contact between the halftone positive and stencil throughout the exposure. Poor contact in any area will cause a loss of dot percentage.
- If the final positive does not include the image of color bars, they should be added. A piece of opaque tape in the trim area of the positive creates an opening in the screen which will print a solid color.
Printing Method
1. Remove any dust or particles from the fabric, the stencil and film sheets by using a tack rag (a varnish-impregnated cloth). Cleanliness and controlling dust are important to getting good results.
2. Hand stir the ink before adding to the press or roller coater.
3. Position the film on the press bed.
4. Hold the film in place with a vacuum.
5. Use the off-contact screen printing method to produce a uniform impression. Make a fill pass and then make the impression pass.

Screen Print Clear
To obtain the stated durability of printed and cleared film, the dry thickness of the clear after drying must be a minimum of 6 microns (0.006 mm) on the printed areas. Usually this thickness can be obtained by one of the following methods:

- **Screen Printing all clears**: Follow the thinning and mesh size recommendations.
- **Roller coating clears 1920DR and 1930**: It is assumed that sufficient clear has been applied if shop records show the clear usage (discounting waste) of at least one gallon of clear, unthinned, for each 2500 square feet coated (3.8 liter per 61.4m²).

Screen Cleaning
Use a commercially-available lacquer thinner, thinners CGS-50, CGS-80 or a blend of solvents such as xylol, methyl ethyl ketone and/or methyl isobutyl ketone and VM&P naphtha. Less aggressive solvents may not clean the screen thoroughly and may adversely affect the print quality of the screen when it is reused.

Non-solvent screen washes must be tested. Some brands may cause the ink to gel in the screen or the reclaimed ink can contaminate unused ink.

1. **IMPORTANT NOTE**

   Ink series 1900 and its clears are not compatible with some solvents commonly used for screen washing and cleanup. All such solvents should be tested before use. The use of incompatible thinner will produce a gummy residue, which will be very difficult to remove.

Drying Ink and Screen Print Clears
Listed below are suggestions for obtaining properly dried graphics. Times and temperatures vary with equipment, amount and type of thinner or retarder, ambient temperature, humidity and air flow.

It is essential that sufficient residual thinner be removed from the graphic before the premask tape is applied. If there is any question as to sufficient dryness, a dryness test should be performed.

Inks and Screen Print Clear 1920DR and 1930

<table>
<thead>
<tr>
<th>Drying Method</th>
<th>Minimum Temperature</th>
<th>Minimum Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air</td>
<td>Ambient</td>
<td>24 hours</td>
</tr>
<tr>
<td>Batch</td>
<td>150°F (64°C)</td>
<td>2 hours</td>
</tr>
<tr>
<td>Conveyor1</td>
<td>150°F (64°C)</td>
<td>30 seconds</td>
</tr>
</tbody>
</table>

1. Conveyor drying is recommended. Check the conveyor temperature at various locations across the belt.

Screen Print Clear VI0402
1. Air dry the sheets for 30 minutes using high volume fans directed at the racks.
2. Then, dry the sheets in the oven for 2 hours at 150°F (64°C).
**IMPORTANT NOTE**

Use as low a drying temperature as possible. Over drying the sheets causes them to change size and makes the finished graphic brittle.

**Dryness Test**

To ensure dryness, test the graphics as follows:

1. This test is designed to set the dryer conditions and approximate dryness.
   a. Touch a printed sheet, face-to-face.
   b. Place the touched area close to your ear and separate the film.
   c. If the graphic is adequately dried, there will be either a slight sound or no discernible sounds when the surfaces separate. If the graphics are not dried, there will be a crackling sound. The louder the sound, the greater the amount of additional drying that is required.

2. This test is designed to definitely determine if adequate drying has occurred.
   a. Place several printed, dried sheets, face-to-face, under a 12 inch (30 cm) stack of film. A weight of 2 pounds/square inch (135 gm/cm²) can be used in place of the film stack.
   b. After 10 minutes, remove the sheets and check for blocking or surface impressions.
   c. If blocking or severe surface impressions are noted, additional drying is required. The temperature may be increased or the conveyor speed may be reduced.

**Registration**

Maintaining good registration is critical to good visual color balance. The single most important factor affecting the ability to maintain registration is drying temperature. It is important to the entire process that drying temperatures be only as high as is absolutely necessary.

**Application Tapes**

After the graphics are thoroughly dry, you should apply a prespace tape or premask tape using a roll applicator. Do not use heat.

There are two types of application tapes. See 3M Instruction Bulletin AT-1 to determine what application tape is recommend for your film or finished graphic.

**Premasking Tape**

Increases stiffness during application while preventing stretching and damage. Use when little or no liner is exposed. See 3M Instruction Bulletin 4.3 for complete details.

**Prespacing Tape**

Holds cut and weeded letters or graphics in place during application and after removing the film liner, while preventing stretching and damage. Use when large amounts of liner are exposed. See 3M Instruction Bulletin 4.3 for complete details.

**Shelf Life, Storage and Shipping**

**Shelf Life**

Use by the expiration date shown on the product packaging. A Use By Date, such as 01Dec2014, is on the ink container product label, as well as the outer shipping carton. Do not use ink that shows signs of gelling.

**Ink Storage Conditions**

- Store the inks at 32 to 80 °F (0 to 27 °C).
- Store the inks in the original container or in other similar containers.
- Do not use ink that shows signs of gelling.
Shipping Finished Graphics
Refer to the base media’s 3M Product Bulletin.

Shipping Ink
For transportation information, please visit http://3M.com/Transportinfo or call 1-800-364-3577 or 651-737-6501.

Bulletin Change Summary
For the most current 3M Technical Information available to successfully use this product, please view this Bulletin electronically and click on the blue underlined links to view the relevant documents. Please read the entire Bulletin thoroughly.

Rev K JULY-2015:
• Updated to new template.