

VERSICOLORS ENAMELS

Series 85CL (Formulated without Lead)

Description: These enamels are based on zinc borosilicate frit. They are most suited for use on one-way packages and other applications that do not require very high chemical resistance.

Substrates: Soda lime glass

Coefficient of Thermal Expansion:
 $\approx 70 \times 10^{-7} / ^\circ\text{C}$

Average Particle Size: 6 microns

Firing: 1100°F to 1140°F (593°C to 616°C) depending upon line speed or tempering.

Film Thickness: 50 microns (2 mils) unfired, 25 microns (1 mil) fired.

Acid Resistance: 5 (DTM 78)*

Detergent Resistance: 5 (DTM 75)*

Lead Content: Products formulated without lead

Cadmium Content: Specific colors are formulated with cadmium (see list)

Average Opacity: Up to complete hiding power depending upon weight of application.

Surface Appearance: Glossy

Vehicles: Products are available in conventional squeegee oil, thermoplastics, spray, roller coat and dry powder forms, as well as decal mediums.

Versicolor Enamels Series 85CL

Product Names and Numbers

<u>Chocolate</u>	29-8014
<u>Deep Ruby**</u>	21-8003
<u>Pagoda Red**</u>	21-8002
<u>Tangerine**</u>	28-8003
<u>Toast</u>	23-8022
<u>Sunlight**</u>	23-8020
<u>Limelight</u>	23-8021
<u>Grass Green</u>	25-8002
<u>Forest Green</u>	26-8011
<u>Kentucky Blue Grass</u>	26-8010
<u>Spruce Blue</u>	27-8028
<u>Soldier Blue</u>	27-8027
<u>Rouge Blue</u>	27-8029
<u>Midnight</u>	24-8037
<u>Cotton White</u>	20-8082

** Products formulated with cadmium

* Information on DTM test methods on pages I and II

Firing Temperature (DTM 59)

Glass softens over a temperature range. Therefore, the flowing of glass enamel frits leading to maturing of glass enamels is a function of temperature, time and the slope of the viscosity curve of the frit. We estimate the maturing point of glass enamel frit by running a carefully controlled trial and by subjectively evaluating the appearance of the fired surface or by measuring gloss.

Firing temperatures listed for our glass enamels are either the lowest temperature at which our enamels “look” mature or exhibit an 80% gloss at 45° of incidence.

Gloss (DTM 80)

We measure the gloss of the enamel surface using a gloss meter with 45° of incidence.

Thermal Expansion Coefficient (DTM 79 and ASTM E-228)

We obtain thermal expansion coefficients by slowly heating a two-inch rod formed from an annealed production melt sample of each frit and measure its change in length while it is being heated.

Measurements given here are for temperature range of 25° to 325° C.

Acid #1 (DTM 78)

In evaluating acid resistance, a 10% citric acid solution is applied to an enamel surface in one spot, then covered by a one-inch diameter watch glass and exposed for 15 minutes at room temperature. The resulting stain, if any, is graded as follows:

1. No attack apparent.
2. Appearance of iridescence or visible stain on the exposed surface when viewed at a 45° angle but not apparent at angles less than 30°.
3. A definite stain that does not blur reflected images and is visible at angles less than 30°.
4. Definite stain with a gross color change or strongly iridescent surface visible at angles less than 30° and which may blur reflected images.
5. Surface dull or matte with chalking possible.
6. Significant removal of enamel with pinholing evident.
7. Complete removal of enamel in exposed area.

Heavy Metal Release (HMR) (DTM 77 and 70)

Fired enamel is exposed to a 4% acidic acid solution for 24 hours. Using an atomic adsorption spectrophotometer, the amount of lead and cadmium dissolved in the acid is then determined.

Coatings for lip and rim applications formulated with low HMR enamels must meet allowable lead release limits set by the Federal Register at 50ppm lead and 3.5ppm cadmium for tumbler applications. The acid volume used to determine heavy metal concentration is based on the volume of the tumbler. (The leached area tested is the 2cm band at the tumbler’s lip and rim.)

To eliminate the ware geometry factor in computing HMR values, the values of HMR listed for each Veriscolor Enamels series are essentially micrograms per square centimeter values. When applying low HMR and food contact HMR enamels to vessels, an estimate of the expected HMR can be useful. HMR is estimated by determining the surface area of enamel applied, multiplying by the number of micrograms of heavy metal release expected per square centimeter, and dividing by the container volume.

Several important factors can influence the results of HMR expected from frit, particularly the type of furnace used to fire the ware. A combustion heated furnace or an electric furnace with water injection will yield order of magnitude lower HMR values than those listed here. Frits fired using our standard firing procedure, which consistently maintains a lead release below 10ppm, should perform satisfactorily in most commercial tumbler applications. Frits with lead release less than 15ppm and cadmium release less than 1.5ppm should perform satisfactorily in most food contact environments. Regardless of the published results, it is important to establish that the HMR values on finished ware be acceptable to our customers when fired in their production furnaces.



Alkali #1 (DTM 63)

In this qualitative test, the sample is immersed in a solution of 10% alkali at 88°C for 4 hours and then graded on the appearance of the exposed enamel surface as follows:

1. No attack apparent.
2. Appearance of iridescence or visible stain on the exposed surface when viewed at a 45° angle but not apparent at angles less than 30°.
3. A definite stain that does not blur reflected images and is visible at angles less than 30°.
4. Definite stain with a gross color change or strongly iridescent surface visible at angles less than 30° and which may blur reflected images.
5. Surface dull or matte with chalking possible.
6. Significant removal of enamel with pinholing evident.
7. Complete removal of enamel in exposed area.

Alkali #2

In this quantitative test, we measure the weight loss from a known surface area of decoration exposed to a boiling 10% alkali solution during a two-hour period.

Detergent #1 (DTM 75)

In this test, a decorated enamel is exposed to a 0.3% industrial dishwasher detergent solution at 95°C for 24 hours. Exposed samples are then rinsed, dried and graded qualitatively on the appearance as follows:

1. No attack apparent.
2. Appearance of iridescence or visible stain on the exposed surface when viewed at a 45° angle but not apparent at angles less than 30°.
3. A definite stain that does not blur reflected images and is visible at angles less than 30°.
4. Definite stain with a gross color change or strongly iridescent surface visible at angles less than 30° and which may blur reflected images.
5. Surface dull or matte with chalking possible.
6. Significant removal of enamel with pinholing evident.
7. Complete removal of enamel in exposed area.

Important Note on Heavy Metal Release

Factors such as atmospheric conditions during firing, peak temperatures and time/temperature profiles can strongly influence the physical and chemical properties of fired enamels. Other variables may also affect an enamel's properties. Therefore, we can predict only the expected properties of enamels fired under properly controlled processing conditions.

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