

STATE OF CALIFORNIA
Department of Transportation
Specification for
Thermoplastic Traffic Striping Material,
Alkyd Resin Binder, White and Lead-Free Yellow

1.0 SCOPE

This specification covers a hot-melt, retroreflective, thermoplastic traffic marking material that is suitable for producing durable traffic stripes and pavement markings on Portland cement concrete or asphalt concrete pavements. This material is heated and applied to road surfaces in a molten state using a mechanical applicator. While still hot, reflectorizing glass beads are applied to the surface of the applied thermoplastic striping material. Upon cooling to normal pavement temperatures this material shall produce durable, adherent, retroreflective traffic stripes and pavement markings that are capable of resisting deformation by traffic.

2.0 APPLICABLE SPECIFICATIONS

The following specifications, test methods and standards in effect on the opening date of the Invitation for Bid form a part of this specification where referenced.

- California Test Methods (CTM); No. 423 and No. 660 (latest revision).
- California Department of Transportation, Standard Specifications, May 2006.
- Federal Standard Designation: No. 595b, color #33538.
- U.S. Environmental Protection Agency (EPA), SW-846, Methods 3052 and 6010B.
- American Association of State Highway and Transportation Officials, (AASHTO) Designation: M 247.
- American Society for Testing and Materials, (ASTM) Designations; D 476, D 2794, D 3335, D 3718, D 5380, D 5381, D 6628, E 11, E 28, E 313, E 1621, E 1710 and G 155.
- Commission International de l'Eclairage (C.I.E.) 1931 Chromaticity Diagram.
- California Code of Regulations: Title 22, Division 4.5.

3.0 REQUIREMENTS**3.1 Composition:**

The thermoplastic material shall be composed of 100% solids. The binder shall consist of a maleic-modified glycerol ester of rosin which is homogeneously blended together with all necessary prime pigments, fillers, glass beads and additives to produce a traffic striping material that meets the requirements as specified herein. All thermoplastic material shall be free from; lead, chromium, cadmium, barium and other toxic metals.

3.1.1 White Material:

White thermoplastic shall contain a minimum of 10% (by weight) titanium dioxide pigment meeting ASTM D476 Type II (Rutile). The titanium dioxide content will be determined using ASTM Designations; D 5380 and E 1621. White thermoplastic must meet the Retroreflectivity requirement when applied with drop-on glass beads.

3.1.2 Lead-Free Yellow Material:

Lead-Free (L/F) yellow thermoplastic shall contain proper amounts of C.I. Pigment Yellow 83 (opaque version) and titanium dioxide (Rutile) to produce a yellow material that has a weather-fast and heat stable yellow color which meets the; Yellow Color, Reflectance, Color Stability (Accelerated Weathering) and Retroreflectivity requirements as stated herein. Other pigments may be added to achieve these color requirements. The L/F yellow thermoplastic material shall appear yellow during both daytime and nighttime conditions when applied with drop-on beads.

3.1.3 Other Ingredients:

The remainder of the thermoplastic composition shall be determined by the manufacturer - within the constraints of the requirements below. It shall be the manufacturer's responsibility to produce a thermoplastic material containing the necessary plasticizers, antioxidants, and all other additives so that the thermoplastic will retain its color, viscosity and all other properties as specified herein. In addition to being essentially lead and chromium free, the thermoplastic shall not contain any hazardous materials at levels that would cause the thermoplastic to be classified as a hazardous waste under Title 22, Division 4.5 of the California Code of Regulations.

3.2 Form:

The thermoplastic material shall be supplied in either block or granular form as requested in the purchase order.

3.3 Application Type/Viscosity:

Two viscosity grades of thermoplastic material shall be available for purchase; Extruded-Viscosity and Low-Viscosity. Extruded-Viscosity grade is more suitable for screed type applicators and thicker applications (+2.5mm), including recessed applications. Low-Viscosity grade material is commonly used with ribbon or spray type applicators. The thermoplastic material shall be formulated to meet the viscosity grade specified in the purchase order.

3.4 Characteristics of the Finished Thermoplastic:

Use California Test Method No. 423 (CTM 423) unless otherwise specified.

	<u>White</u>	<u>L/F Yellow</u>
3.4.1 Glass Bead Content, intermixed, Percent by weight, CTM 423 (Part 4). Glass beads shall meet AASHTO Designation: M 247 Type I, except the glass beads shall not contain more than 200 ppm (total) arsenic, 200 ppm (total) antimony, nor more than 200 ppm (total) lead, when tested according to EPA Methods 3052 and 6010B. Other suitable x-ray fluorescence spectrometry analysis methods may be used to screen samples of glass beads for arsenic, antimony and lead content.	30-35	30-35

3.4.2	Binder Content, percent by weight, minimum. CTM 423 (Part 3).	<u>White</u> 18	<u>L/F Yellow</u> 18
3.4.3	Inert Fillers, insoluble in hydrochloric acid, percent passing a sieve with openings of 150 μ m, percent by weight, minimum, ASTM Designation: E 11.	<u>White</u> 100	<u>L/F Yellow</u> 100
3.4.4	Titanium Dioxide (Rutile) Pigment meeting ASTM Designation D476 Type II. Analyze titanium dioxide content using ASTM Designation: D 5380 and E 1621 percent by weight, minimum.	<u>White</u> 10	<u>L/F Yellow</u> ---
3.4.5	Specific Gravity, maximum, CTM 423 (Part 5).	<u>White</u> 2.15	<u>L/F Yellow</u> 2.15
3.4.6	Ring and Ball Softening Point, CTM 423 (Part 6), ASTM Designation: E 28.	<u>White</u> 93-121°C	<u>L/F Yellow</u> 93-121°C
3.4.7	Perform the remaining tests on the material after 4 hours heating with stirring at 218 \pm 2°C. This 4-hour period includes time required (~1 hr.) for melting and temperature stabilization of the 6 kg. sample.		
3.4.7.1	Tensile Bond Strength to an unprimed abrasive blasted Portland cement concrete brick, 3.2 mm thick film draw down at 218°C, tested at 25 \pm 2°C, MPa, minimum, CTM 423 (Part 7).	<u>White</u> 1.24 MPa	<u>L/F Yellow</u> 1.24 MPa
3.4.7.2	Brookfield Thermosel Viscosity, Low-Viscosity Grade ----- Extrude-Viscosity Grade ----- Spindle SC4-27, 20 rpm at 218°C, Pa•s, CTM 423 (Part 8).	<u>White</u> <4.5 4.5 to 10	<u>L/F Yellow</u> <4.5 4.5 to 10
3.4.7.3	Impact Resistance, 3.2 mm thick film draw down at 218°C on an unprimed abrasive blasted Portland cement concrete brick, male indenter 15.9 mm diameter, no female die. Test at 25 \pm 2°C, kilogram force•meter, with no; chips, cracks or bond loss, minimum, CTM 423 (Part 9), ASTM Designation D 2794.	<u>White</u> 0.58	<u>L/F Yellow</u> 0.58

3.4.7.4 Daylight Luminous Reflectance, CTM 423 (Part 11) except use a BYK-Gardner “Color-Guide” Spectrophotometer. Follow the manufacturer’s instructions to obtain the Reflectance or “Y” value. Set-up the spectrophotometer for 2° Observer and Illuminant “C” measurement conditions.	<u>White</u> 80 Minimum	<u>L/F Yellow</u> 42 to 59
3.4.7.5 Yellow Color, shall match Federal Standard Designation: No. 595b, color #33538 and shall lie within the following chromaticity limits “colorbox” defined by plotting the following four (x,y) pairs on a C.I.E. 1931 Chromaticity diagram; (x1,y1) = (0.5125, 0.4866) (x2,y2) = (0.4865, 0.4647) (x3,y3) = (0.5000, 0.4416) (x4,y4) = (0.5348, 0.4646) Reflectance(Y) shall be between 42 and 59. Measurement conditions = 2°Observer/illuminant “C”. Tested according to CTM 423 (Part 10) except use a BYK-Gardner “Color-Guide” Spectrophotometer to measure the color. Follow the manufacturers instructions to obtain the (x,y) chromaticity coordinates. See attached Yellow Color graph.	<u>White</u> ---	<u>L/F Yellow</u> Pass
3.4.7.6 Yellowness Index, maximum Follow CTM 423 (Part 11) except use a BYK-Gardner “Color-Guide” Spectrophotometer to measure the Yellowness Index of the white thermoplastic using the ASTM Designation: E313 mode.	<u>White</u> 10	<u>L/F Yellow</u> ---
3.4.7.7 Color Stability after Accelerated Weathering, ASTM Designation: G 155, Table X3.1, Cycle 1, 500 hours total exposure time. Prepare sample by dipping a sheet aluminum panel into the molten thermoplastic and removing it to obtain a 1.5 to 3mm coating thickness of thermoplastic on the panel. Place the panel in the weathering apparatus for 500 hrs. After accelerated weathering, measure the Yellow Color or Yellowness Index as in section 3.4.7.5 or 3.4.7.6 above. Material must meet the color stability requirement below, after this exposure.		

	White - Yellowness Index, maximum	<u>White</u> 20	<u>L/F Yellow</u> ---
	Yellow - Measured chromaticity coordinates must fall within a "colorbox" defined by plotting the following four (x,y) pairs on a C.I.E. 1931 Chromaticity diagram. See attached Yellow Color graph. (x1, y1) = (0.5125, 0.4866) (x2, y2) = (0.4650, 0.4466) (x3, y3) = (0.4750, 0.4251) (x4, y4) = (0.5348, 0.4646)	---	Pass
3.4.7.8	Hardness, Shore A-2 Durometer, measure according to CTM 423 (Part 12) except condition the sample for 2 hrs. in a 46.1°C water bath before measuring the Hardness. The Durometer is also conditioned at 46.1°C in a forced air oven. Remove the sample from the water bath and quickly place the Durometer on the sample while starting a stopwatch. Record the Hardness after 15 seconds. The total weight of the Durometer shall be 2000 grams. Note: Thermoplastic for recessed application shall have a Hardness between 30 and 50.	<u>White</u> 45 to 75	<u>L/F Yellow</u> 45 to 75
3.4.7.9	Abrasion Test Use 400 g of graded glass beads between 600 and 850 µm diameter and an air pressure of 152 kPa to sandblast the sample in 4 different areas according to CTM 423 (Part 14), total weight loss, grams, maximum.	<u>White</u> 10	<u>L/F Yellow</u> 10
3.4.7.10	Lead, mg/kg in thermoplastic, maximum, ASTM D3335	<u>White</u> 20	<u>L/F Yellow</u> 20
3.4.7.11	Chromium, mg/kg in thermoplastic, maximum, ASTM D3718	<u>White</u> 5	<u>L/F Yellow</u> 5
3.4.7.12	Initial Retroreflectivity of applied thermoplastic striping (with beads), $\text{mcd} \cdot \text{m}^{-2} \cdot \text{lx}^{-1}$, minimum	<u>White</u> 250	<u>L/F Yellow</u> 175

The thermoplastic shall produce delineation and pavement markings that have the required minimum level of retroreflectivity when applied with drop-on beads. Drop-on glass beads shall be uniformly applied at a minimum rate of 4-kg of beads per 10 square meters of thermoplastic. The retroreflectivity shall be measured as specified in ASTM E 1710-05.

3.4.7.13 Color after Application

The daytime color of the applied white and yellow thermoplastic traffic stripes and pavement markings (with drop-on beads) shall meet the color requirements in section 3.4.7.7 (Color Stability after Accelerated Weathering). The color shall be measured within 60 days of application using a portable BYK-Gardner “Color-Guide” Spectrophotometer (see sections 3.4.7.5 and 3.4.7.6).

3.5 Other Requirements:**3.5.1 Melting and Applicability:**

Bags of thermoplastic shall not harden during shipment and storage to the point where the material must be broken-up with tools before loading into the melter. When heated, the thermoplastic material shall completely melt to a homogeneous fluid with satisfactory application qualities and shall be free of debris. The molten thermoplastic material shall be readily applied at temperatures between 204°C and 232°C. Upon application to the pavement, the thermoplastic material shall be sufficiently tack-free to carry traffic; in not more than 2 minutes when the pavement surface temperature is 16°C, and in not more than 10 minutes when the pavement surface temperature is 54°C.

3.5.2 Workmanship:

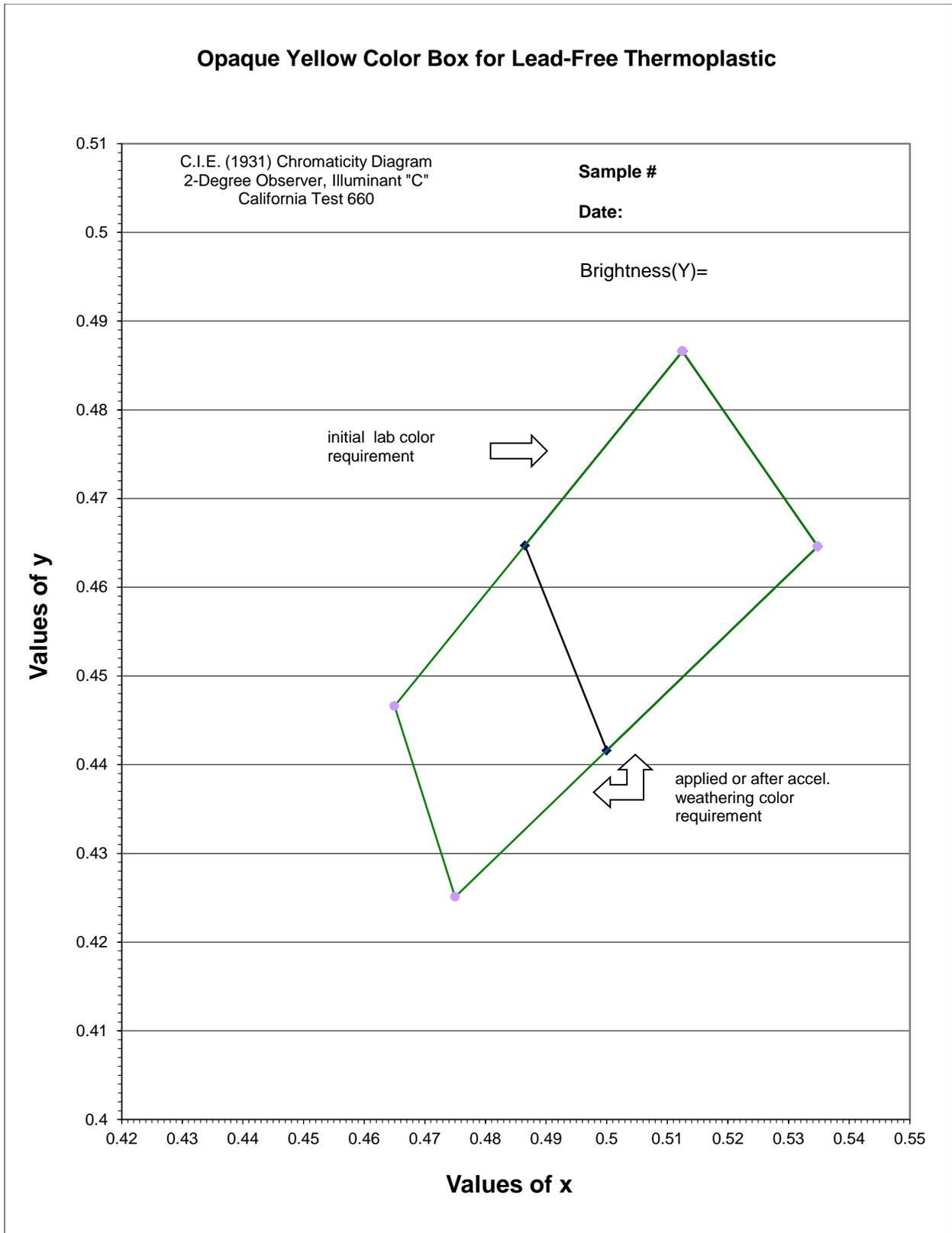
The materials’ ingredients (resins, pigments, glass beads, fillers and additives) shall be homogeneously blended. The finished product shall be uniform from bag to bag. The melted thermoplastic material shall have no indications of resin separation or incompatibility of resins when melted or after cooling. The material shall be free from all; dirt, water, foreign matter, and other deleterious substances capable of clogging; screens, valves, pumps and other striping apparatus. The thermoplastic material shall be of such composition that it will not bleed, stain, or discolor when applied to pavements.

3.5.3 Shelf Life:

The material shall maintain the requirements of this specification for a minimum period of one (1) year from the date of manufacture. Any materials failing to do so shall be replaced at the expense of the manufacturer. Ordered thermoplastic shall be no more than 120 days old (based on date of manufacture) upon delivery to a Department of Transportation Maintenance facility. The date of manufacture shall be clearly marked on each bag of thermoplastic.

3.5.4 Air Pollution Compliance:

This material shall comply with all applicable air pollution control rules and regulations. The thermoplastic material shall not emit fumes that are toxic or injurious to persons or property when it is heated to application temperature. The material shall not emit excessive smoke during heating or application.



STATE OF CALIFORNIA
Department of Transportation
Specification for
Sprayable Thermoplastic Traffic Striping Material,
White and Lead-Free Yellow

1.0 SCOPE

This specification covers a hot-melt, retroreflective, thermoplastic traffic marking material that is suitable for producing durable traffic stripes and pavement markings on Portland cement concrete or asphalt concrete pavements. This material is heated and applied to road surfaces in a molten state using a mechanical applicator. While still hot, reflectorizing glass beads are applied to the surface of the applied thermoplastic striping material. Upon cooling to normal pavement temperatures this material shall produce durable, adherent, retroreflective traffic stripes and pavement markings that are capable of resisting deformation by traffic.

2.0 APPLICABLE SPECIFICATIONS

The following specifications, test methods and standards in effect on the opening date of the Invitation for Bid form a part of this specification where referenced.

- California Test Methods (CTM); No. 423 and No. 660 (latest revision).
- California Department of Transportation, Standard Specifications, May 2006.
- Federal Standard Designation: No. 595b, color #33538.
- U.S. Environmental Protection Agency (EPA), SW-846, Methods 3052 and 6010B.
- American Association of State Highway and Transportation Officials, (AASHTO) Designation: M 247.
- American Society for Testing and Materials, (ASTM) Designations; D 476, D 2794, D 3335, D 3718, D 5380, D 5381, D 6628, E 11, E 28, E 313, E 1621, E 1710, and G 155.
- Commission International de l'Eclairage (C.I.E.) 1931 Chromaticity Diagram.
- California Code of Regulations: Title 22, Division 4.5.

3.0 REQUIREMENTS

3.1 Composition:

The thermoplastic material shall be composed of 100% solids. The binder shall consist of hydrocarbon or alkyd thermoplastic resins which are homogeneously blended together with all necessary prime pigments, fillers, glass beads and additives to produce a traffic striping material that meets the requirements as specified herein. The type of resin binder (alkyd or hydrocarbon) may be specified in the purchase order. All thermoplastic material shall be free from; lead, chromium, cadmium, barium and other toxic metals.

3.1.1 White Material:

White thermoplastic shall contain a minimum of 10% (by weight) titanium dioxide pigment meeting ASTM D476 Type II (Rutile). The titanium dioxide content will be determined using ASTM Designations; D 5380 and E 1621. White thermoplastic must meet the Retroreflectivity requirement when applied with drop-on glass beads.

3.1.2 Lead-Free Yellow Material:

Lead-Free (L/F) yellow thermoplastic shall contain proper amounts of C.I. Pigment Yellow 83 (opaque version) and titanium dioxide (Rutile) to produce a yellow material that has a weather-fast and heat stable yellow color which meets the; Yellow Color, Reflectance, Color Stability (Accelerated Weathering) and Retroreflectivity requirements as stated herein. Other pigments may be added to achieve these color requirements. The L/F yellow thermoplastic material shall appear yellow during both daytime and nighttime conditions when applied with drop-on beads.

3.1.3 Other Ingredients:

The remainder of the thermoplastic composition shall be determined by the manufacturer - within the constraints of the requirements below. It shall be the manufacturer's responsibility to produce a thermoplastic material containing the necessary plasticizers, antioxidants, and other additives so that the thermoplastic will retain its color, viscosity and all other properties as specified herein. In addition to being essentially lead and chromium free, the thermoplastic shall not contain any hazardous materials at levels that would cause the thermoplastic to be classified as a hazardous waste under Title 22, Division 4.5 of the California Code of Regulations.

3.2 **Form:**

The thermoplastic material shall be supplied in either block or granular form as requested in the purchase order.

3.3 **Application Type/Viscosity:**

The thermoplastic material shall be suitable for air-atomized spray application at temperatures between 177°C and 204°C. The viscosity of the molten material at these temperatures shall be suitable for applying thermoplastic traffic stripes that are ~1.0-mm thick.

3.4 **Characteristics of the Finished Thermoplastic:**

Use California Test Method No. 423 (CTM 423) unless otherwise specified.

	<u>White</u>	<u>L/F Yellow</u>
3.4.1 Glass Bead Content, intermixed, percent by weight, CTM 423 (Part 4). Glass beads shall meet AASHTO Designation: M 247 Type I, except the glass beads shall not contain more than 200 ppm (total) arsenic, 200 ppm (total) antimony, nor more than 200 ppm (total) lead, when tested according to EPA Methods 3052 and 6010B. Other suitable x-ray fluorescence spectrometry analysis methods may be used to screen samples of glass beads for arsenic, antimony and lead content.	30-35	30-35
3.4.2 Binder Content, percent by weight, minimum. CTM 423 (Part 3).	<u>White</u> 25	<u>L/F Yellow</u> 25

3.4.3	Inert Fillers, insoluble in hydrochloric acid, percent passing a sieve with openings of 150 μ m, percent by weight, minimum, ASTM Designation: E 11.	<u>White</u> 100	<u>L/F Yellow</u> 100
3.4.4	Titanium Dioxide (Rutile) Pigment meeting ASTM Designation D476 Type II. Analyze titanium dioxide content using ASTM Designation: D 5380 and E 1621 percent by weight, minimum.	<u>White</u> 10	<u>L/F Yellow</u> ---
3.4.5	Specific Gravity, maximum, CTM 423 (Part 5).	<u>White</u> 2.10	<u>L/F Yellow</u> 2.10
3.4.6	Ring and Ball Softening Point, CTM 423 (Part 6), ASTM Designation: E 28.	<u>White</u> 90°-121°C	<u>L/F Yellow</u> 90°-121°C
3.4.7	Perform the remaining tests on the material after 4 hours heating with stirring at 191 \pm 2°C. This 4-hour period includes time required (~1 hr.) for melting and temperature stabilization of the 6 kg. sample.		
3.4.7.1	Tensile Bond Strength to an unprimed abrasive blasted Portland cement concrete brick, 1.6 mm thick film draw down at 191°C, tested at 25 \pm 2°C, MPa, minimum, CTM 423 (Part 7).	<u>White</u> 1.24 MPa	<u>L/F Yellow</u> 1.24 MPa
3.4.7.2	Brookfield Thermosel Viscosity, Spindle SC4-27, 20 rpm at 191°C, Pa•s, CTM 423 (Part 8).	<u>White</u> <2.0	<u>L/F Yellow</u> <2.0
3.4.7.3	Impact Resistance, 1.6 mm thick film draw down at 191°C on an unprimed abrasive blasted Portland cement concrete brick, male indenter 15.9 mm diameter, no female die. Test at 25 \pm 2°C, kilogram force•meter, with no; chips, cracks or bond loss, minimum CTM 423 (Part 9), ASTM Designation D 2794.	<u>White</u> 0.58	<u>L/F Yellow</u> 0.58
3.4.7.4	Daylight Luminous Reflectance CTM 423 (Part 11) except use a BYK-Gardner “Color-Guide” Spectrophotometer. Follow the manufacturer’s instructions to obtain the Reflectance or “Y” value. Set-up the spectro-	<u>White</u> 82 Minimum	<u>L/F Yellow</u> 42 to 59

photometer for 2° Observer and Illuminant “C” measurement conditions.

- 3.4.7.5 Yellow Color, shall match Federal Standard Designation: No. 595b, color #33538 and shall lie within the following chromaticity limits “colorbox” defined by plotting the following four (x,y) pairs on a C.I.E. 1931 Chromaticity diagram;
 (x1,y1) = (0.5125, 0.4866)
 (x2,y2) = (0.4865, 0.4647)
 (x3,y3) = (0.5000, 0.4416)
 (x4,y4) = (0.5348, 0.4646)
 Reflectance (Y) shall be between 42 and 59.
 Measurement conditions = 2°Observer/illuminant “C”.
 Tested according to CTM 423 (Part 10) except use a BYK-Gardner “Color-Guide” Spectrophotometer to measure the color. Follow the manufacturer’s instructions to obtain the (x,y) chromaticity coordinates. See attached Yellow Color graph.

<u>White</u>	<u>L/F Yellow</u>
---	Pass

- 3.4.7.6 Yellowness Index, maximum
 Follow CTM 423 (Part 11) except use a BYK-Gardner “Color-Guide” Spectrophotometer to measure the Yellowness Index of the white thermoplastic using the ASTM Designation: E313 mode.

<u>White</u>	<u>L/F Yellow</u>
8	---

- 3.4.7.7 Color Stability after Accelerated Weathering, ASTM Designation: G 155, Table X3.1, Cycle 1, 500 hours total exposure time. Prepare sample by dipping a sheet aluminum panel into the molten thermoplastic and removing it to obtain a 1.0 to 2.0mm coating thickness of thermoplastic on the panel. Place the panel in the weathering apparatus for 500 hrs. After accelerated weathering, measure the Yellow Color or Yellowness Index as in section 3.4.7.5 or 3.4.7.6 above. Material must meet the color stability requirements below after this exposure.

White -	Yellowness Index, maximum	20	---
Yellow -	Measured chromaticity coordinates must fall within a “colorbox” defined by plotting the following four (x,y) pairs on a C.I.E. 1931 Chromaticity diagram. See attached Yellow Color graph. (x1, y1) = (0.5125, 0.4866)	---	Pass

<u>White</u>	<u>L/F Yellow</u>
20	---
---	Pass

$$(x_2, y_2) = (0.4650, 0.4466)$$

$$(x_3, y_3) = (0.4750, 0.4251)$$

$$(x_4, y_4) = (0.5348, 0.4646)$$

3.4.7.8 Hardness, Shore A-2 Durometer, measure according to CTM 423 (Part 12) except condition the sample for 2 hrs. in a 46.1°C water bath before measuring the Hardness. The Durometer is also conditioned at 46.1°C in a forced air oven. Remove the sample from the water bath and quickly place the Durometer on the sample while starting a stopwatch. Record the Hardness after 15 seconds. The total weight of the Durometer shall be 2000 grams.	<u>White</u> 20 to 65	<u>L/F Yellow</u> 20 to 65
3.4.7.9 Abrasion Test Use 400 g of graded glass beads between 600 and 850 µm diameter and an air pressure of 152 kPa to sandblast the sample in 4 different areas according to CTM 423 (Part 14), total weight loss, grams, maximum.	<u>White</u> 10	<u>L/F Yellow</u> 10
3.4.7.10 Lead, mg/kg in thermoplastic, maximum, ASTM D3335	<u>White</u> 20	<u>L/F Yellow</u> 20
3.4.7.11 Chromium, mg/kg in thermoplastic, maximum, ASTM D3718	<u>White</u> 5	<u>L/F Yellow</u> 5
3.4.7.12 Initial Retroreflectivity of applied thermoplastic striping (with beads), $\text{mcd} \cdot \text{m}^{-2} \cdot \text{lx}^{-1}$, minimum	<u>White</u> 250	<u>L/F Yellow</u> 175

The thermoplastic shall produce delineation and pavement markings that have the required minimum level of retroreflectivity when applied with drop-on beads. Drop-on glass beads shall be uniformly applied at a minimum rate of 4-kg of beads per 10 square meters of thermoplastic. The retroreflectivity shall be measured as specified in ASTM E 1710-05.

- 3.4.7.13 Color after Application
The daytime color of the applied white and yellow thermoplastic traffic stripes and pavement markings (with drop-on beads) shall meet the color requirements in section 3.4.7.7 (Color Stability after Accelerated Weathering). The color shall be measured within 60 days of application using a portable BYK-Gardner "Color-Guide" Spectrophotometer (see sections 3.4.7.5 and 3.4.7.6).

3.5 Other Requirements:

- 3.5.1 Melting and Applicability:

Bags of thermoplastic shall not harden during shipment and storage to the point where the material must be broken-up with tools before loading into the melter. When heated, the thermoplastic material shall completely melt to a homogeneous fluid with satisfactory application qualities and shall be free of debris. The molten thermoplastic material shall be readily applied at temperatures between 177°C and 204°C. Upon application to the pavement, the thermoplastic material shall be sufficiently tack-free to carry traffic; in not more than 2 minutes when the pavement surface temperature is 16°C, and in not more than 10 minutes when the pavement surface temperature is 54°C.

3.5.2 Workmanship:

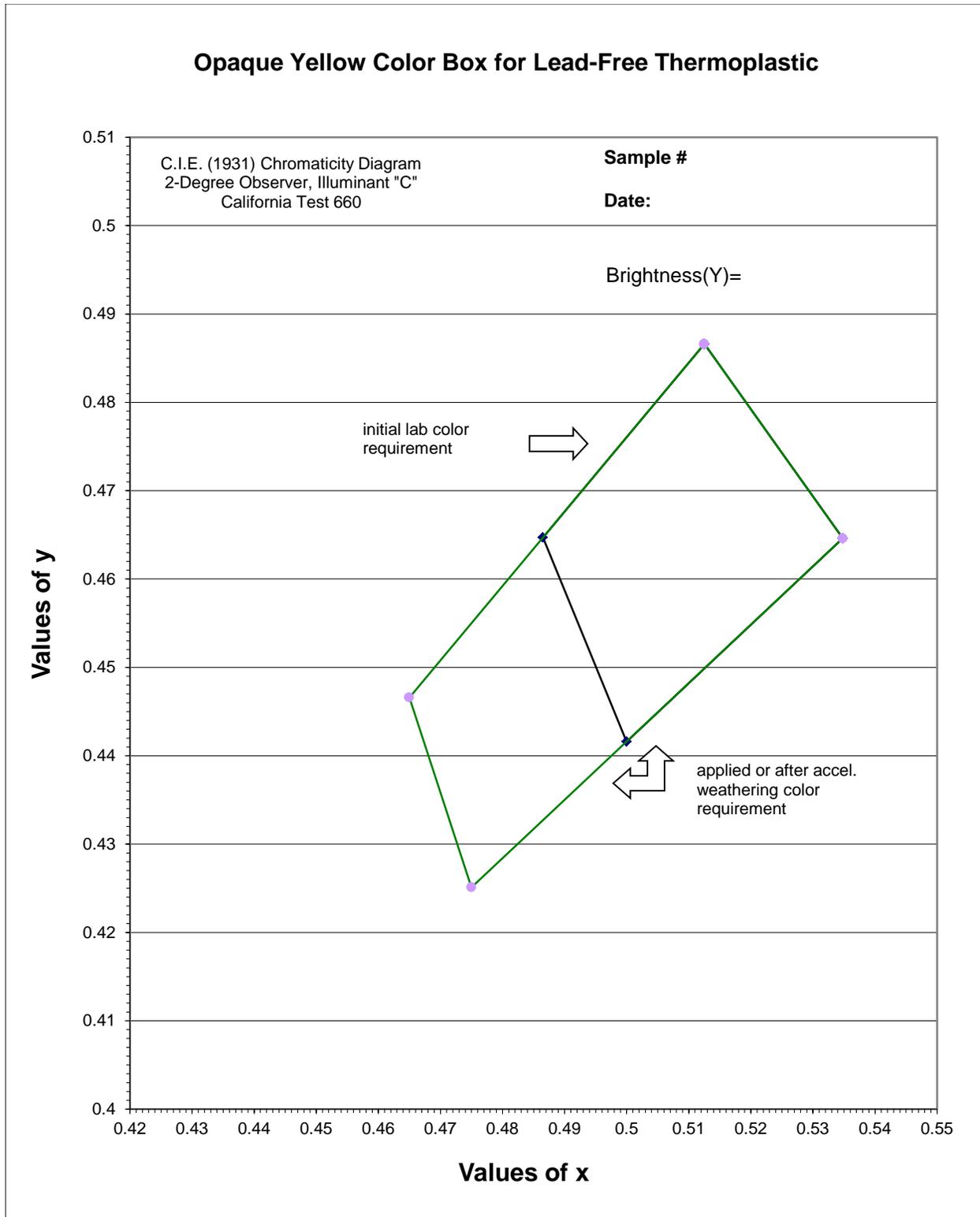
The materials' ingredients (resins, pigments, glass beads, fillers and additives) shall be homogeneously blended. The finished product shall be uniform from bag to bag. The melted thermoplastic material shall have no indications of resin separation or incompatibility of resins when melted or after cooling. The material shall be free from all; dirt, water, foreign matter, and other deleterious substances capable of clogging; screens, valves, pumps and other striping apparatus. The thermoplastic material shall be of such composition that it will not bleed, stain, or discolor when applied to pavements.

3.5.3 Shelf Life:

The material shall maintain the requirements of this specification for a minimum period of one (1) year from the date of manufacture. Any materials failing to do so shall be replaced at the expense of the manufacturer. Ordered thermoplastic shall be no more than 120 days old (based on date of manufacture) upon delivery to a Department of Transportation Maintenance facility. The date of manufacture shall be clearly marked on each bag of thermoplastic.

3.5.4 Air Pollution Compliance:

This material shall comply with all applicable air pollution control rules and regulations. The thermoplastic material shall not emit fumes that are toxic or injurious to persons or property when it is heated to application temperature. The material shall not emit excessive smoke during heating or application.



Thermoplastic Traffic Striping and Pavement Marking Material, Miscellaneous Requirements

1.0 QUALITY ASSURANCE PROVISIONS

1.1 Inspection and Sampling: All thermoplastic material intended for use by the California Department of Transportation (the Department) must be tested and approved by the Transportation Laboratory **before** shipment. Manufacturers shall take two (duplicate) 6 kg. representative samples of each lot of thermoplastic and ship the samples to the Transportation Laboratory for testing. The address of the Transportation Laboratory is listed in section 3.4. A lot shall consist of a batch or consecutive batches of thermoplastic manufactured on the same day using the same formulation. A batch shall be that amount of thermoplastic that was manufactured and packaged in a single operation. Thermoplastic from the same lot shall be palletized, shrink-wrapped, labeled with the manufacturer's lot and batch numbers (on each pallet) and batch number (on each bag) and stored in a common area to facilitate random sampling of the entire lot by the Inspector. A lot shall be more than 900 kg and shall be less than 20,000 kg. of thermoplastic.

Manufacturers must submit the following information along with the two representative 6 kg samples of each lot for testing.

1. State Specification number (#PTH-02ALKYD, or #PTH-02SPRAY).
2. Manufacturer's Product number
3. Color; (White or Lead-Free Yellow) and kgs. represented by samples.
4. Identification numbers of batches comprising the lot, and lot number.
5. Date of manufacture.
6. Form (block or granular).
7. Viscosity (Sprayable, Low-Viscosity or Extrude-Viscosity)
8. Binder Type (hydrocarbon or alkyd).
9. Sampling method (splitting, thieving, quartering, random bag, etc.).
10. Purchase Order or Contract number.

A manufacturer's test report shall also be included with the representative duplicate samples of each lot sent to the Transportation Laboratory. The following information shall be included in the manufacturer's test report:

- Brookfield Thermosel Viscosity @ 218°C (or at 191°C for Spray-Type)
- Hardness
- Binder Content
- Glass Bead Content
- Daylight Luminous Reflectance
- Yellow Color (for yellow only)
- Yellowness Index (for white only)

Attachment B

The samples and above information shall be sent to the Transportation Laboratory at the address listed in section 3.4. A Certificate of Compliance (see section 3.1) shall accompany the samples.

Once the Transportation Laboratory approves a lot of thermoplastic, the manufacturer will be notified that the lot is approved for shipment. When shipments of the approved lots/batches of thermoplastic are made to a Department of Transportation Maintenance facility, the manufacturer shall fax the following information to the Transportation Laboratory within 48 hours of the shipping date. Out of State manufacturers shall also fax the following information to the Transportation Laboratory whenever shipments of approved lots/batches are shipped to warehouses, resellers, or Contractors within the State of California.

- State Specification number (#PTH-02ALKYD, or #PTH-02SPRAY).
- A list of each delivery location and delivery dates.
- Name and phone number of contact person(s) at the delivery location(s).
- Colors, batch/lot numbers and quantity of material comprising shipment.
- Purchase Order number or Contract number and date that order was received.

This information shall be faxed to: Transportation Laboratory, Chemical Testing Section, 5900 Folsom Blvd., Sacramento, CA 95819-0128, attn.: Lisa Dobeck, Fax (916) 227-7168.

1.2 Random Sampling: The Department of Transportation reserves the right to take random samples of lots/batches of thermoplastic, destined for use by the Department, at the manufacturer's facility. Sampling may also be done at the Contractor's warehouse or jobsite. If requested by the Inspector, batch tickets must also be provided for batches of thermoplastic produced for the Department. The Department of Transportation also reserves the right to retest any batch/lot of thermoplastic after delivery. Results from such retesting shall prevail over all other tests and will be the basis of rejection. Material not meeting the specification shall be removed and replaced by the supplier at their expense, including all costs for handling, retesting and shipping.

1.3 Testing: All tests shall be performed according to the specified test methods (latest revision) mentioned in the material specifications. The manufacturer shall maintain a laboratory sufficiently staffed and equipped so as to maintain the quality of the product as called for in these specifications.

2.0 PREPARATION FOR DELIVERY

2.1 Packaging:

2.1.1 Block Form:

The thermoplastic material shall be packaged in suitable containers to which it will not adhere nor interact during shipment and storage. The blocks of cast thermoplastic material shall be approximately 900 by 300 by 50 mm and shall weigh approximately 22.7 kg. The containers shall be palletized as specified in the contract or purchase order.

Attachment B

2.1.2 Granular Form:

The thermoplastic material shall be packaged in meltable bags which are compatible with the thermoplastic and which weigh approximately 22.7 kg when filled. The containers must have sufficient strength and be properly sealed to prevent breakage and leakage during normal handling. The bags shall be shrink-wrapped to reduce shifting of the bags on the pallet and shall be palletized as specified in the contract or purchase order.

2.1.3 Palletizing:

Each pallet shall be loaded with forty (40) bags - (one ton). Bags shall be stacked on the pallets to a nominally flat top surface to facilitate handling and storage.

An appropriately sized pallet pad made of chipboard (minimum thickness = 0.022 inch) shall be placed on the pallet before stacking of bags of thermoplastic onto the pallet.

2.1.4 Broken bags:

F.O.B. destination shall be returned to the supplier at the supplier's expense. If the supplier does not elect to have the broken bags of thermoplastic returned, it may elect to have Caltrans arrange other disposal at the supplier's expense. In any case, no payment shall be made to the supplier for any material arriving F.O.B. destination in broken bags. In addition, the supplier is required to replace the quantity of order arriving F.O.B. destination in broken bags within fourteen (14) days of notification by the State.

2.2 Markings: Each individual unit/container of product shall be labeled. This label shall include: State Specification number (#PTH-02ALKYD, or #PTH-02SPRAY), color, type of binder, manufacturer's name and address, date of manufacture and batch number. Additionally, each bag shall be labeled with the production lot, bag weight, safety information, temperature to be heated and recommended shelf life. Lead-free yellow materials shall be marked "Lead-Free". Thermoplastic meant for recessed application shall be marked "For Recessed Application". All markings on containers shall be legible and permanent. Markings shall not smear or rub-off container.

Containers failing to meet marking requirements will not be accepted.

The containers and labeling shall meet all applicable US Department of Transportation and Interstate Commerce Commission regulations. Concerning the content, each container shall be labeled with such warnings or precautions as are required by; Local, State and Federal laws and requirements.

3.0 NOTES

3.1 Certificates of Compliance: The manufacturer of thermoplastic materials shall furnish the Engineer with a Certificate of Compliance in conformance with the provisions of the California Department of Transportation Standard Specifications, May 2006, section 6-1.07, "Certificate of Compliance." The Certificate shall also include a list, by title and section; of all applicable State and Federal packaging and labeling laws and a statement that all requirements have been met. Certificates of Compliance shall be sent

Attachment B

along with each delivery of thermoplastic and also with samples sent to the Transportation Laboratory for testing.

3.2 Material Safety Data Sheets: The manufacturer shall provide Material Safety Data Sheets (MSDS's) with each delivery of thermoplastic. These MSDS's shall include health hazard information on the material when it is heated to application temperature (218°C).

3.3 Patents: The Contractor shall assume all costs arising from the use of patented; materials, equipment, devices or processes used on or incorporated in the work, and further agrees to indemnify and save harmless the State of California and its duly authorized representatives from all suits at law or action of every nature for or on account of the use of any patented; materials, equipment, devices or processes.

3.4 Contact Information: Please send samples to the Transportation Laboratory for testing at the address below.

California Department of Transportation
Transportation Laboratory – Chemistry Section
5900 Folsom Blvd.
Sacramento, CA 95819
Attention: Lisa Dobeck
Phone: (916) 227-7291
Fax: (916) 227-7168



**STATE OF CALIFORNIA
ENVIRONMENTAL BID SPECIFICATION
THERMOPLASTIC TRAFFIC STRIPING MATERIAL**

1. SCOPE

This document establishes the requirements and specifications for implementation of Environmentally Preferable Purchasing (EPP) as mandated by the California Public Contract Code (PCC), Chapter 6, Sections 12400-12404.

The law requires, “the procurement or acquisition of goods and services that have a lesser or reduced effect on human health and the environment when compared with competing goods and services that serve the same purpose.” Comparison requires evaluating for associated impacts from the product’s raw materials acquisition, production, manufacturing, packaging, distribution, reuse, operation, maintenance, disposal, energy efficiency, product performance, durability, safety, the needs of the purchaser, and cost. As part of this solicitation bidders must be compliant with mandatory requirements and are encouraged to participate in environmental stewardship efforts by offering packaging materials that conserve natural resources and reduce environmental impacts.

2. APPLICABLE SPECIFICATIONS / STANDARDS

- 2.1** Specifications and standards referenced in this document are in effect on the opening of the bid proposal and form a part of this specification.
- 2.2** Bidder shall comply with requirements of following standards and codes as they apply:
 - 2.2.1** California Public Contract Code, Sections 12200-12217
 - 2.2.2** California Health and Safety Code, Sections 25214.11- 25214.26
 - 2.2.3** California Code of Regulations, Title 8, Section 5194
 - 2.2.4** ASTM Standard Specifications D 6400-04 and ASTM 6400-00

3. REQUIREMENTS

3.1 Post Consumer Recycle Content Certification

3.1.1 PCRC Percentages Worksheet

Contractor(s) shall complete the PCRC Percentages Worksheet listing the percentage of post consumer recycled content material for each product offered as identified and described in the pricing worksheet.

3.1.2 Letter of Certification

Contractor(s) shall sign the Letter of Certification certifying that the minimum percentage, if not exact percentage, listed in the PCRC Percentages Worksheet is accurate. The Letter of Certification shall be provided regardless of content, even if the product(s) contain no post consumer recycled material and be furnished under penalty of perjury.

3.1.3 Reportable Product Categories Table

The product categories table is provided and is for informational purposes only and identifies the 11 reportable SABRC product categories.

Attachment B

Within 30 calendar days from contract award, the Contractor will be required to provide a signed Letter of Certification and completed PCRC Percentages Worksheet to the State Contract Administrator. The PCRC Percentages Worksheet shall be provided in hard copy and electronic copy (on a CD-ROM in Microsoft Excel format).

During the life of the contract, the Contractor(s) will be required to submit revised PCRC Certification Workbook information if percentages are adjusted or if substitute line items are approved by the State Contract Administrator.

3.2 Packaging, Packing and Marking

- 3.2.1 No Polyvinylchloride (PVC) plastic bags or films are permitted for packaging. Containers and corrugated boxes are to be readily recyclable, without coating or other treated substances such as wax prohibiting or limiting repulpability. Markings to be made of ink manufactured in USA or bidder to declare in writing inks are free of heavy metals.
- 3.2.2 Rigid Plastic Containers when used shall comply with the California Rigid Plastic Packaging Container Law, PRC §42300-42345. Certificate verification required <http://www.calrecycle.ca.gov/Plastics/RPPC/Certification/> .

3.3 Packaging Materials

- 3.3.1 Bidders shall offer bio-degradable or compostable packaging materials meeting ASTM Standard Specifications for Compostable Plastics D 6400-04 and ASTM 6400-00 Standard for packing materials marked Biodegradable. Packaging that is melted in with thermoplastic traffic striping material and becomes a component of the striping material are exempt from the biodegradable and/or compostable requirement.
- 3.3.2 Paper and wood products (i.e. labeling, packaging, catalogs or wood pallets) shall be Process Chlorine Free (PCF). Bidders are encouraged to use paper and wood products produced from a company participating in a forest stewardship program where the forest is managed to conserve biological diversity, natural resources and maintain a thriving ecosystem.

3.4 Toxics in Packaging

All packages, packaging components, and packaged retail-ready products offered during the life of the contract must be in full compliance with all requirements of the Toxics in Packaging Prevention Act (Health and Safety Code (HSC) sections 25214.11-25214.26.) "Package" and "packaging components" are defined in HSC section 25214.12. Provisions for exemption from this Act are contained in HSC section 25214.14.

Upon request by the State, the awarded supplier shall provide a Certificate of Compliance which covers each type of package, packaging component, or packaged retail-ready product supplied,

Attachment B

distributed, or sold under this specification. The certification shall be based either on direct written correspondence from the packaging product manufacturer or from any written advertisement issued by the product manufacturer including, but not limited to, the products label, the manufacturers catalog, or the manufacturers or vendors.

Internet Web site.

More information can be found at: <http://www.dtsc.ca.gov/ToxicsInPackaging/index.cfm>

3.5 Hazardous Substance Declaration

Products, that contain hazardous substances, as defined by California Code of Regulations, 8CCR §5194, Hazard Communication, shall comply with the requirements of the regulations including section 5194(g), Material Safety Data Sheets (MSDS).

The Contractor must provide a Material Safety Data Sheet (MSDS), via facsimile or email, to the ordering agency upon written request.