

## Item P-620 Runway and Taxiway Marking

### DESCRIPTION

**620-1.1** This item shall consist of the preparation and painting of numbers, markings, and stripes on the surface of runways, taxiways, and aprons, in accordance with these specifications and at the locations shown on the plans, or as directed by the Engineer. The terms “paint” and “marking material” as well as “painting” and “application of markings” are interchangeable throughout this specification.

### MATERIALS

**620-2.1 Materials acceptance.** The Contractor shall furnish manufacturer’s certified test reports for materials shipped to the project. The certified test reports shall include a statement that the materials meet the specification requirements. The reports can be used for material acceptance or the Engineer may perform verification testing. The reports shall not be interpreted as a basis for payment. The Contractor shall notify the Engineer upon arrival of a shipment of materials to the site. All material shall arrive in sealed containers 55 gallons or smaller for inspection by the Engineer. Material shall not be loaded into the equipment until inspected by the Engineer.

**620-2.2 Marking materials.** Paint shall be [ waterborne, epoxy, methacrylate, solvent-base, or preformed thermoplastic ] in accordance with the requirements of paragraph 620-2.2 [\_\_\_]. Paint shall be furnished in [\_\_\_] in accordance with Federal Standard No. 595.

\*\*\*\*\*

**The Engineer shall specify paint type (s) and appropriate paragraph number (s).**

**The Engineer shall insert the colors to be used on a project from the following list:**

<u>Fed Std. No 595 Color</u>	<u>Number</u>
White	37925
Red	31136
Yellow	33538 or 33655
Black	37038
Pink	1 part 31136 to 2 parts 37925
Green	34108

**Waterborne or solvent base black paint should be used to outline a border at least 6 inch (150 mm) wide around markings on all light colored pavements. Preformed thermoplastic markings shall have a non-reflectorized black border integral to the marking.**

**For TT-P-1952E and A-A-2886B paints, the Engineer shall specify the type required:**

- **Type I is intended for those locations where slower tracking is not a problem.**
- **Type II is intended for locations where faster curing is desirable.**

- **Type III requires the use of cross linking resin which will produce a thicker, more durable coating.**

**When more than one paint type is specified, the plans should clearly indicate paint type for each marking.**

\*\*\*\*\*

[ **a. Waterborne.** Paint shall meet the requirements of Federal Specification TT-P-1952E, [ Type I ] [ Type II ] [ Type III ]. The non-volatile portion of the vehicle for all paint types shall be composed of a 100% acrylic polymer as determined by infrared spectral analysis. [ The acrylic resin used for Type III shall be 100% cross linking acrylic as evidenced by infrared peaks at wavelengths 1568, 1624, and 1672 cm-1 with intensities equal to those produced by an acrylic resin known to be 100% cross linking. ]

[ **b. Epoxy.** Paint shall be a two component, minimum 99% solids type system conforming to the following:

(1) **Pigments.** Component A. Percent by weight.

(a) **White:**

Titanium Dioxide, ASTM D476, type II shall be 18% minimum (16.5% minimum at 100% purity).

(b) **Yellow and Colors:**

Titanium Dioxide, ASTM D476, type II shall be 14 to 17%.

Organic yellow, other colors, and tinting as required to meet color standard.

Epoxy resin shall be 75 to 79%.

(2) **Epoxy content.** Component A. The weight per epoxy equivalent, when tested in accordance with ASTM D1652 shall be the manufacturer's target  $\pm 50$ .

(3) **Amine number.** Component B. When tested in accordance with ASTM D2074 shall be the manufacturer's target  $\pm 50$ .

(4) **Prohibited materials.** The manufacturer shall certify that the product does not contain mercury, lead, hexavalent chromium, halogenated solvents, nor any carcinogen as defined in 29 CFR 1910.1200 in amounts exceeding permissible limits as specified in relevant Federal Regulations.

(5) **Daylight directional reflectance.**

(a) **White:** The daylight directional reflectance of the white paint shall not be less than 75% (relative to magnesium oxide), when tested in accordance with ASTM E2302.

(b) **Yellow:** The daylight directional reflectance of the yellow paint shall not be less than 55% (relative to magnesium oxide), when tested in accordance with ASTM E2302. The x and y values shall be consistent with the Federal Hegman yellow color standard chart for traffic yellow standard 33538, or shall be consistent with the tolerance listed below:

x	.462	x	.470	x	.479	x	.501
y	.438	y	.455	y	.428	y	.452

**(6) Accelerated weathering.**

**(a) Sample preparation.** Apply the paint at a wet film thickness of 0.013 inch (0.33 mm) to four 3 × 6 inch (8 × 15 cm) aluminum panels prepared as described in ASTM E2302. Air dry the sample 48 hours under standard conditions.

**(b) Testing conditions.** Test in accordance with ASTM G154 using both Ultra Violet (UV-B) Light and condensate exposure, 72 hours total, alternating four (4) hour UV exposure at 140°F (60°C), and four (4) hours condensate exposure at 104°F (40°C).

**(c) Evaluation.** Remove the samples and condition for 24 hours under standard conditions. Determine the directional reflectance and color match using the procedures in paragraph 620-2.2b(5) above. Evaluate for conformance with the color requirements.

**(7) Volatile organic content.** Determine the volatile organic content in accordance with 40 CFR Part 60 Appendix A, Method 24.

**(8) Dry opacity.** Use ASTM E2302. The wet film thickness shall be 0.015 inch (0.38 mm). The minimum opacity for white and colors shall be 0.92.

**(9) Abrasion resistance.** Subject the panels prepared in paragraph 620-2.2b(6) to the abrasion test in accordance with ASTM D968, Method A, except that the inside diameter of the metal guide tube shall be from 0.747 to 0.750 inch (18.97 to 19.05 mm). Five liters (17.5 lb (7.94 kg)) of unused sand shall be used for each test panel. The test shall be run on two test panels Both baked and weathered paint films shall require not less than 150 liters (525 lbs (239 kg)) of sand for the removal of the paint films.

**(10) Hardness, shore.** Hardness shall be at least 80 when tested in accordance with ASTM D2240. ]

[ **c. Methacrylate.** Paint shall be a two component, minimum 99% solids-type system conforming to the following:

**(1) Pigments.** Component A. Percent by weight.

**(a) White:**

Titanium Dioxide, ASTM D476, type II shall be 6% minimum.

Methacrylate resin shall be 18% minimum.

**(b) Yellow and Colors:**

Titanium Dioxide, ASTM D476, type II shall be 6% minimum.

Organic yellow, other colors, and tinting as required to meet color standard.

Methacrylate resin shall be 18% minimum.

**(2) Prohibited materials.** The manufacturer shall certify that the product does not contain mercury, lead, hexavalent chromium, halogenated solvents, nor any carcinogen as defined in 29 CFR

1910.1200 in amounts exceeding permissible limits as specified in relevant Federal Regulations.

**(3) Daylight directional reflectance:**

**(a) White:** The daylight directional reflectance of the white paint shall not be less than 80% (relative to magnesium oxide), when tested in accordance with ASTM E2302.

**(b) Yellow:** The daylight directional reflectance of the yellow paint shall not be less than 55% (relative to magnesium oxide), when tested in accordance with ASTM E2302. The x and y values shall be consistent with the Federal Hegman yellow color standard chart for traffic yellow standard 33538, or shall be consistent with the tolerance listed below:

x	.462	x	.470	x	.479	x	.501
y	.438	y	.455	y	.428	y	.452

**(4) Accelerated weathering.**

**(a) Sample preparation.** Apply the paint at a wet film thickness of 0.013 inch (0.33 mm) to four 3 × 6 inch (8 × 15 cm) aluminum panels prepared as described in ASTM E2302. Air dry the sample 48 hours under standard conditions.

**(b) Testing conditions.** Test in accordance with ASTM G154 using both Ultra Violet (UV-B) Light and condensate exposure, 72 hours total, alternating four (4) hour UV exposure at 140°F (60°C), and four (4) hours condensate exposure at 104°F (40°C).

**(c) Evaluation.** Remove the samples and condition for 24 hours under standard conditions. Determine the directional reflectance and color match using the procedures in paragraph 620-2.2c(3) above. Evaluate for conformance with the color requirements.

**(5) Volatile organic content.** Determine the volatile organic content in accordance with 40 CFR Part 60 Appendix A, Method 24.

**(6) Dry opacity.** Use ASTM E2302. The wet film thickness shall be 0.015 inch (0.38 mm). The minimum opacity for white and colors shall be 0.92.

**(7) Abrasion resistance.** Subject the panels prepared in paragraph 620-2.2c(4) to the abrasion test in accordance with ASTM D968, Method A, except that the inside diameter of the metal guide tube shall be from 0.747 to 0.750 inch (18.97 to 19.05 mm). Five liters (17.5 lb (7.94 kg)) of unused sand shall be used for each test panel. The test shall be run on two test panels Both baked and weathered paint films shall require not less than 150 liters (525 lbs (239 kg) of sand for the removal of the paint films.

**(8) Hardness, shore.** Hardness shall be at least 80 when tested in accordance with ASTM D2240. ]

[ **d. Solvent-Base.** Paint shall meet the requirements of Commercial Item Description [ A-A-2886B Type I, Type II, and Type III ]. ]

[ **e. Preformed Thermoplastic Airport Pavement Markings.** Markings must be composed of ester modified resins in conjunction with

aggregates, pigments, and binders that have been factory produced as a finished product. The material must be impervious to degradation by aviation fuels, motor fuels, and lubricants.

(1) The markings must be able to be applied in temperatures as low as 35°F without any special storage, preheating, or treatment of the material before application.

(a) The markings must be supplied with an integral, non-reflectorized black border.

**(2) Graded glass beads.**

(a) The material must contain a minimum of 30% intermixed graded glass beads by weight. The intermixed beads shall conform to [ Federal Specification TT-B-1325D, Type I, gradation A ] [ Federal Specification TT-B-1325D, Type IV ].

(b) The material must have factory applied coated surface beads in addition to the intermixed beads at a rate of one (1) lb (0.45 kg) (±10%) per 10 square feet (1 sq m). These factory applied coated surface beads shall have a minimum of 90% true spheres, minimum refractive index of 1.50, and meet the following gradation.

Size Gradation		Retained, %	Passing, %
U.S. Mesh	µm		
12	1700	0 - 2	98 - 100
14	1400	0 - 3.5	96.5 - 100
16	1180	2 - 25	75 - 98
18	1000	28 - 63	37 - 72
20	850	63 - 72	28 - 37
30	600	67 - 77	23 - 33
50	300	89 - 95	5 - 11
80	200	97 - 100	0 - 3

(3) **Heating indicators.** The material manufacturer shall provide a method to indicate that the material has achieved satisfactory adhesion and proper bead embedment during application and that the installation procedures have been followed.

**(4) Pigments.** Percent by weight.

(a) White:

Titanium Dioxide, ASTM D476, type II shall be 10% minimum.

(b) Yellow and Colors:

Titanium Dioxide, ASTM D476, type II shall be 1% minimum.

Organic yellow, other colors, and tinting as required to meet color standard.

(5) **Prohibited materials.** The manufacturer shall certify that the product does not contain mercury, lead, hexavalent chromium, halogenated solvents, nor any carcinogen as defined in 29 CFR

1910.1200 in amounts exceeding permissible limits as specified in relevant Federal Regulations.

**(6) Daylight directional reflectance.**

(a) White: The daylight directional reflectance of the white paint shall not be less than 75% (relative to magnesium oxide), when tested in accordance with ASTM E2302.

(b) Yellow: The daylight directional reflectance of the yellow paint shall not be less than 45% (relative to magnesium oxide), when tested in accordance with ASTM E2302. The x and y values shall be consistent with the Federal Hegman yellow color standard chart for traffic yellow standard 33538, or shall be consistent with the tolerance listed below:

x	.462	x	.470	x	.479	x	.501
y	.438	y	.455	y	.428	y	.452

**(7) Skid resistance.** The surface, with properly applied and embedded surface beads, must provide a minimum resistance value of 45 BPN when tested according to ASTM E303.

**(8) Thickness.** The material must be supplied at a nominal thickness of 65 mil (1.7 mm).

**(9) Environmental resistance.** The material must be resistant to deterioration due to exposure to sunlight, water, salt, or adverse weather conditions and impervious to aviation fuels, gasoline, and oil.

**(10) Retroreflectivity.** The material, when applied in accordance with manufacturer's guidelines, must demonstrate a uniform level of nighttime retroreflection when tested in accordance to ASTM E1710.

**(11) Packaging.** Packaging shall protect the material from environmental conditions until installation.

**(12) Preformed thermoplastic airport pavement marking requirements.**

(a) The markings must be a resilient thermoplastic product with uniformly distributed glass beads throughout the entire cross-sectional area. The markings must be resistant to the detrimental effects of aviation fuels, motor fuels and lubricants, hydraulic fluids, deicers, anti-icers, protective coatings, etc. Lines, legends, and symbols must be capable of being affixed to asphalt and/or Portland cement concrete pavements by the use of a large radiant heater. Colors shall be available as required.

(b) The markings must be capable of conforming to pavement contours, breaks, and faults through the action of airport traffic at normal pavement temperatures. The markings must be capable of fully conforming to grooved pavements, including pavement grooving per advisory circular (AC) 150/5320-12, current version. The markings shall have resealing characteristics, such that it is capable of fusing with itself and previously applied thermoplastics when heated with a heat source per manufacturer's recommendation.

(c) Multicolored markings must consist of interconnected individual pieces of preformed thermoplastic pavement marking material, which through a variety of colors and patterns, make up the desired design. The individual pieces in each large marking segment (typically more than 20 feet (6 m) long) must be factory assembled with a compatible material and interconnected so that in the field it is not necessary to assemble the individual pieces within a marking segment. Obtaining multicolored effect by overlaying materials of different colors is not acceptable due to resulting inconsistent marking thickness and inconsistent application temperature in the marking/substrate interface.

(d) The marking material must set up rapidly, permitting the access route to be re-opened to traffic after application.

(e) The marking material shall have an integral color throughout the thickness of the marking material. ]

\*\*\*\*\*

**Thermoplastic airport markings will be subject to an Engineering life-cycle cost analysis prior to inclusion in specifications.**

\*\*\*\*\*

**620-2.3 Reflective media.** Glass beads shall meet the requirements for [\_\_\_]. Glass beads shall be treated with all compatible coupling agents recommended by the manufacturers of the paint and reflective media to ensure adhesion and embedment.

\*\*\*\*\*

Paint Color	Glass Beads, Type I, Gradation A	Glass Beads, Type III	Glass Beads, Type IV
White	See Table 1	See Table 1	See Table 1
Yellow	See Table 1	See Table 1	See Table 1
Red	See Table 1 and Note	Not used	See Table 1 and Note
Pink	See Table 1 and Note	Not used	See Table 1 and Note
Black	Not used	Not used	Not used
Green	Not used	Not used	Not used

**The Engineer should insert all that will be used in the project. When more than one bead type is specified, the plans should indicate the bead type for each marking.**

**Federal Specification TT-B-1325D, Type I, gradation A shall be used when remarking on a frequent basis (at least every six months), and should yield at least 300 mcd/m<sup>2</sup>/lux on white markings at installation and at least 175 mcd/m<sup>2</sup>/lux on yellow markings at installation.**

**Federal Specification TT-B-1325D, Type III, gradation A shall be used when a higher reflective value is desired. Initial readings should yield at least 600 mcd/m<sup>2</sup>/lux on white markings and at least 300 mcd/m<sup>2</sup>/lux on yellow markings at installation.**

**Federal Specification TT-B-1325D, Type IV, gradation A shall be used with TT-P-1952E, Type III paint. The glass beads are larger than either Type I or Type III, thus requiring more of the coating material to properly anchor. When applied properly in 25-30 mils wet film thickness (wft) of the high build acrylic waterborne material, reflective readings should yield at least 400 mcd/m<sup>2</sup>/lux on white markings and at least 225 mdc/m<sup>2</sup>/lux on yellow markings at installation. The Engineer should consult with the paint and bead manufacturer on the use of adhesion, flow promoting, and/or flotation additives.**

**Preformed thermoplastic pavement markings should yield at least 225 mcd/m<sup>2</sup>/lux on white markings at installation and at least 100 mcd/m<sup>2</sup>/lux on yellow markings at installation.**

**Retroreflectivity shall be measured by a portable retroreflectometer according to ASTM E1710 and the practices in ASTM D7585 shall be followed for taking retroreflectivity readings with a portable retroreflectometer and computing measurement averages. A van-mounted retroreflectometer may also be used.**

\*\*\*\*\*

**CONSTRUCTION METHODS**

**620-3.1 Weather limitations.** The painting shall be performed only when the surface is dry and when the surface temperature is at least 45°F (7°C) and rising and the pavement surface temperature is at least 5°F (2.7°C) above the dew point or meets the manufacturer’s recommendations. [ Painting operations shall be discontinued when the surface temperature exceeds [ ]°F ([ ]°C. ] [ Markings shall not be applied when the pavement temperature is greater than 130°F (55°C). ] Markings shall not be applied when the wind speed exceeds 10 mph unless windscreens are used to shroud the material guns.

\*\*\*\*\*

**The Engineer may specify minimum and maximum surface and dew point temperatures based on paint manufacturer’s recommendations.**

\*\*\*\*\*

**620-3.2 Equipment.** Equipment shall include the apparatus necessary to properly clean the existing surface, a mechanical marking machine, a bead dispensing machine, and such auxiliary hand-painting equipment as may be necessary to satisfactorily complete the job.

The mechanical marker shall be an atomizing spray-type or airless-type marking machine suitable for application of traffic paint. It shall produce an even and uniform film thickness at the required coverage and shall apply markings of uniform cross-sections and clear-cut edges without running or spattering and without over spray.

**620-3.3 Preparation of surface.** Immediately before application of the paint, the surface shall be dry and free from dirt, grease, oil, laitance, or other foreign material that would reduce the bond between the paint and the pavement. The area to be painted shall be cleaned by [ waterblasting, ]



[ shotblasting, ][ grinding ] or [ sandblasting ] or by other methods as required to remove all contaminants without damage to the pavement surface. Use of any chemicals or impact abrasives during surface preparation shall be approved in advance by the Engineer. After the cleaning operations, sweeping, blowing, or rinsing with pressurized water shall be performed to ensure the surface is clean and free of grit or other debris left from the cleaning process.

[ Paint shall not be applied to Portland cement concrete pavement until the areas to be painted are clean of curing material. Sandblasting or high-pressure water shall be used to remove curing materials. ]

At least 24 hours prior to remarking existing markings, the existing markings must be removed such that [ 75% ][ 90% ] of the existing markings are removed with low (3,500-10,000 psi) waterblaster. After waterblasting, the surface shall be cleaned of all residue or debris either with sweeping or blowing with compressed air or both.

Prior to the initial application of markings, the Contractor shall certify in writing that the surface has been prepared in accordance with the paint manufacturer’s requirements, that the application equipment is appropriate for the type of marking paint and that environmental conditions are appropriate for the material being applied. This certification along with a copy of the paint manufacturer’s surface preparation and application requirements must be submitted and approved by the Engineer prior to the initial application of markings.

\*\*\*\*\*

**The Engineer should specify any additional surface preparation or test applications required and should specify the type of surface preparation to be used when existing markings interfere with or would cause adhesion problems with new markings.**

**Shotblasting is not recommended on grooved surfaces.**

\*\*\*\*\*

**620-3.4 Layout of markings.** The proposed markings shall be laid out in advance of the paint application. The locations of markings to receive glass beads shall be shown on the plans. [ The locations of markings to receive silica sand shall be shown on the plans. ]

\*\*\*\*\*

**Glass beads improve conspicuity and the friction characteristics of markings. At a minimum, the Engineer shall indicate the following locations to receive glass beads per AC 150/5340-1, Standards for Airport Markings:**

- 1. All holding position markings used on runways, taxiways, and holding bays and used to indicate instrument landing system/microwave landing system (ILS/MLS) or precision obstacle-free zone (POFZ) critical areas.**
- 2. Runway threshold marking.**
- 3. Runway threshold bar.**
- 4. Runway aiming point marking.**
- 5. Runway designation marking.**
- 6. Runway touchdown zone markings.**

7. Runway centerline marking.
8. All taxiway centerline markings and enhanced taxiway centerline markings.
9. Geographical position marking.
10. Surface painted signs for holding position signs, taxiway direction signs, taxiway location signs, gate destination signs, and apron entrance point signs.
11. Non-movement area boundary marking

The following locations are recommended to receive glass beads:

1. Runway side stripes.
2. Taxiway edge markings.
3. Runway displaced threshold markings.
4. Runway demarcation bar.

\*\*\*\*\*

**620-3.5 Application.** Paint shall be applied at the locations and to the dimensions and spacing shown on the plans. Paint shall not be applied until the layout and condition of the surface has been approved by the Engineer. The edges of the markings shall not vary from a straight line more than 1/2 inch (12 mm) in 50 feet (15 m), and marking dimensions and spacings shall be within the following tolerances:

Dimension and Spacing	Tolerance
36 inch (910 mm) or less	±1/2 inch (12 mm)
greater than 36 inch to 6 feet (910 mm to 1.85 m)	±1 inch (25 mm)
greater than 6 feet to 60 feet (1.85 m to 18.3 m)	±2 inch (50 mm)
greater than 60 feet (18.3 m)	±3 inch (76 mm)

The paint shall be mixed in accordance with the manufacturer's instructions and applied to the pavement with a marking machine at the rate shown in Table 1. The addition of thinner will not be permitted. A period of [ ] shall elapse between placement of a bituminous surface course or seal coat and application of the paint.

Prior to the initial application of markings, the Contractor shall certify in writing that the surface has been prepared in accordance with the paint manufacturer's requirements, that the application equipment is appropriate for the marking paint and that environmental conditions are appropriate for the material being applied. This certification along with a copy of the paint manufacturer's application and surface preparation requirements must be submitted to the Engineer prior to the initial application of markings.

**620-3.6 Test strip.** Prior to the full application of airfield markings, the Contractor shall produce a test strip in the presence of the Engineer. The test strip shall include the application of a minimum of 5 gallons (4 liters) of paint and application of 35 lbs (15.9 kg) of Type I/50 lbs (22.7 kg) of Type III glass beads. The test strip shall be used to establish thickness/darkness standard for all markings. The test strip shall cover no more than the maximum area prescribed in Table 1 (e.g., for 5 gallons (19 liters) of waterborne paint shall cover no more than 575 square feet (53.4 m<sup>2</sup>).

**Table 1. Application Rates For Paint And Glass Beads  
(See Note regarding Red and Pink Paint)**

Paint Type	Paint Square feet per gallon, ft <sup>2</sup> /gal (Sq m per liter, m <sup>2</sup> /l)	Glass Beads, Type I, Gradation A Pounds per gallon of paint-lb/gal (Km per liter of paint-kg/l)	Glass Beads, Type III Pounds per gallon of paint-lb/gal (Km per liter of paint-kg/l)	Glass Beads, Type IV Pounds per gallon of paint-lb/gal (Km per liter of paint-kg/l)
*	*	*	*	*
*	*	*	*	*

\*\*\*\*\*

The Engineer shall specify the application rates for paint and glass beads from the following table.

**Application Rates For Paint And Glass Beads For Table 1**

Paint Type	Paint Square feet per gallon, ft <sup>2</sup> /gal (Sq m per liter, m <sup>2</sup> /l)	Glass Beads, Type I, Gradation A Pounds per gallon of paint-lb/gal (Km per liter of paint-kg/l)	Glass Beads, Type III Pounds per gallon of paint-lb/gal (Km per liter of paint-kg/l)	Glass Beads, Type IV Pounds per gallon of paint-lb/gal (Km per liter of paint-kg/l)
<b>Waterborne Type I or II</b>	115 ft <sup>2</sup> /gal max (2.8 m <sup>2</sup> /l)	7 lb/gal min (0.85 kg/l)	10 lb/gal min (1.2 kg/l)	--
<b>Waterborne Type III</b>	90 ft <sup>2</sup> /gal max (2.2 m <sup>2</sup> /l)	--	10 lb/gal min (1.2 kg/l)	
<b>Waterborne Type III</b>	55 ft <sup>2</sup> /gal max (1.4 m <sup>2</sup> /l)			8 lb/gal min (1.0 kg/l)
<b>Solvent Base</b>	115 ft <sup>2</sup> /gal max (2.8 m <sup>2</sup> /l)	7 lb/gal min (0.85 kg/l)	10 lb/gal min (1.2 kg/l)	--
<b>Solvent Base</b>	55 ft <sup>2</sup> /gal max (2.2 m <sup>2</sup> /l)	--	--	8 lb/gal min (1.0 kg/l)
<b>Epoxy</b>	90 ft <sup>2</sup> /gal max (2.2 m <sup>2</sup> /l)	15 lb/gal min (1.8 kg/l)	20 lb/gal min (2.4 kg/l)	16 lb/gal min (1.9 kg/l)
<b>Methacrylate</b>	45 ft <sup>2</sup> /gal max (1.1 m <sup>2</sup> /l)	15 lb/gal min (1.8 kg/l)	20 lb/gal min (2.4 kg/l)	16 lb/gal min (1.8 kg/l)

**Note:** The glass bead application rate for Red and Pink paint shall be reduced by 2 lb/gal (0.24 kg/l) for Type I and Type IV beads. Type III beads shall not be applied to Red or Pink paint.

The Engineer shall specify the time period in order to allow adequate curing of the pavement surface. The Engineer should contact the paint manufacturer to determine the wait period.

Due to the increased surface area to cover, the following should be substituted when painting Porous Friction Course with waterborne or solvent based paints:

**“The paint shall be mixed in accordance with the manufacturer’s instructions and applied to the pavement with a marking machine from two directions at 50% with no glass beads in the first direction, and 100% with glass beads or sand in the other direction.”**

**Markings may be required before paving operations are complete. The Engineer may wish to specify waterborne or solvent-based materials for temporary markings at 30% to 50% of the specified application rates (for example, rate/0.50). No glass beads are required for temporary markings. TT-P-1952E, Type II or A-A-2886B, Type III may be used for temporary markings when reflectorized temporary markings are desired. Glass beads will not adhere well at the low application rates for temporary markings and require immediate sweeping and cleanup before aircraft are allowed to use the pavement.**

\*\*\*\*\*

\*\*\*\*\*

**It is recommended when using waterborne paints on previously unmarked asphalt or seal coat, that an initial paint coat at 50% of the permanent coverage rates be applied for white markings to reduce the discoloration that occurs.**

**New concrete pavements should be allowed to cure for eight to twelve weeks before removing the curing compound and installing permanent markings.**

\*\*\*\*\*

Glass beads shall be distributed upon the marked areas at the locations shown on the plans to receive glass beads immediately after application of the paint. A dispenser shall be furnished that is properly designed for attachment to the marking machine and suitable for dispensing glass beads. Glass beads shall be applied at the rate shown in Table 1. Glass beads shall not be applied to black paint or green paint. Glass beads shall adhere to the cured paint or all marking operations shall cease until corrections are made. Different bead types shall not be mixed. Regular monitoring of glass bead embedment should be performed.

All emptied containers shall be returned to the paint storage area for checking by the Engineer. The containers shall not be removed from the airport or destroyed until authorized by the Engineer.

\*\*\*\*\*

**A 24- to 30-day waiting period is recommended for all types of paint used for pavement marking. If the airport operations require pavement marking prior to the recommended waiting period, the paint may be applied in a temporary light coat application. Appropriate modifications to paragraph 3.5 should be included to specify a 30% to 50% application rate for temporary markings. Glass beads are not required for temporary markings. TT-P-1952E, Type II or A-A-2886B, Type III may be used for temporary markings when reflectorized temporary markings are desired. Glass beads will not adhere well at the low application rates for temporary markings and require immediate sweeping and cleanup before aircraft are allowed to use the pavement.**

**The final application should occur after the waiting period has passed. The final marking application must be at full strength in order to adequately set the glass bead.**

\*\*\*\*\*

### **620-3.7 Application--preformed thermoplastic airport pavement markings.**

**a. Asphalt and Portland cement.** To ensure minimum single-pass application time and optimum bond in the marking/substrate interface, the materials must be applied using a variable speed self-propelled mobile heater with an effective heating width of no less than 16 feet (5 m) and a free span between supporting wheels of no less than 18 feet (5.5 m). The heater must emit thermal radiation to the marking material in such a manner that the difference in temperature of 2 inches (50 mm) wide linear segments in the direction of heater travel must be within 5% of the overall average temperature of the heated thermoplastic material as it exits the heater. The material must be able to be applied at ambient and pavement temperatures down to 35°F (2°C) without any preheating of the pavement to a specific temperature. The material must be able to be applied without the use of a thermometer. The pavement shall be clean, dry, and free of debris. A non-volatile organic content (non-VOC) sealer with a maximum applied viscosity of 250 centiPoise must be applied to the pavement shortly before the markings are applied. The supplier must enclose application instructions with each box/package.

**620-3.8 Protection and cleanup.** After application of the markings, all markings shall be protected from damage until dry. All surfaces shall be protected from excess moisture and/or rain and from disfiguration by spatter, splashes, spillage, or drippings. The Contractor shall remove from the work area all debris, waste, loose or unadhered reflective media, and by-products generated by the surface preparation and application operations to the satisfaction of the Engineer. The Contractor shall dispose of these wastes in strict compliance with all applicable state, local, and Federal environmental statutes and regulations.

## **METHOD OF MEASUREMENT**

**620-4.1** The quantity of runway and taxiway markings to be paid for shall be [ the number of square feet (square meters) of painting and the number of pounds (kg) of reflective media ] [ the number of square feet (square meters) of preformed markings ] [ one complete item in place ] performed in accordance with the specifications and accepted by the Engineer.

## **BASIS OF PAYMENT**

**620-5.1** Payment shall be made at the respective contract [ price per square foot (square meter) ] [ lump sum price ] for runway and taxiway painting [ , and [ price per pound (kg) ] [ lump sum price ] [ price per square foot (square meter) ] [ lump sum price ] for preformed markings ] for reflective media. This price shall be full compensation for furnishing all materials and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

Item P-620-5.1-1      Runway and Taxiway Marking [ per square foot (square meter) ] [ lump sum ]

\*\*\*\*\*

**The Engineer should include a pay item for each paint type and color and bead type material specified.**

\*\*\*\*\*

Item P-620-5.1-2 Reflective Media [ per pound (km) ] [ lump sum ]

#### TESTING REQUIREMENTS

ASTM C371	Standard Test Method for Wire-Cloth Sieve Analysis of Nonplastic Ceramic Powders
ASTM D92	Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester
ASTM D711	Standard Test Method for No-Pick-Up Time of Traffic Paint
ASTM D968	Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM D1652	Standard Test Method for Epoxy Content of Epoxy Resins
ASTM D2074	Standard Test Method for Total, Primary, Secondary, and Tertiary Amine Values of Fatty Amines by Alternative Indicator Method
ASTM D2240	Standard Test Method for Rubber Property - Durometer Hardness
ASTM D7585	Standard Practice for Evaluating Retroreflective Pavement Markings Using Portable Hand-Operated Instruments
ASTM E1710	Standard Test Method for Measurement of Retroreflective Pavement Marking Materials with CEN-Prescribed Geometry Using a Portable Retroreflectometer
ASTM E2302	Standard Test Method for Measurement of the Luminance Coefficient Under Diffuse Illumination of Pavement Marking Materials Using a Portable Reflectometer
ASTM G154	Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials

#### MATERIAL REQUIREMENTS

ASTM D476	Standard Classification for Dry Pigmentary Titanium Dioxide Products
40 CFR Part 60, Appendix A-7, Method 24	Determination of volatile matter content, water content, density, volume solids, and weight solids of surface coatings
29 CFR Part 1910.1200	Hazard Communication
FED SPEC TT-B-1325D	Beads (Glass Spheres) Retro-Reflective
American Association of State Highway and Transportation Officials (AASHTO) M247	Standard Specification for Glass Beads Used in Pavement Markings
FED SPEC TT-P-1952E	Paint, Traffic and Airfield Marking, Waterborne

Commercial Item Description A-A-2886B

Paint, Traffic, Solvent Based

FED STD 595

Colors used in Government Procurement

AC 150/5340-1

Standards for Airport Markings

**END OF ITEM P-620**