
USACE / NAVFAC / AFCEA UFGS-02761N (August 2002)

Preparing Activity: NAVFAC Superseding
UFGS-02761N (October 2001)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated 25 June 2004

Revised throughout - changes not indicated by CHG tags

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8/02

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SECTION 02761N

PAVEMENT MARKINGS

8/02

NOTE: This guide specification covers the requirements for new markings and remarking requirements for airfields, roads, streets, and parking areas by means of painting.

Comments and suggestions on this guide specification are welcome and should be directed to the technical proponent of the specification. A listing of technical proponents, including their organization designation and telephone number, is on the Internet.

Recommended changes to a UFGS should be submitted as a Criteria Change Request (CCR).

Use of electronic communication is encouraged.

Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.

NOTE: Where curbs, obstructions, and other appurtenant structures are included in the work, the same general requirements will apply but hand application with pneumatic spray guns will be used in these areas.

Criteria and standard requirements for pavement markings are provided in the following publications:

1. American National Standards Institute (ANSI)

D6.1d-1986 - Uniform Traffic Control Devices for Streets and Highways

2. Naval Air System Command Publication:

NAVAIR 51-50AAA-2 - Shorebased Airfield Marking and Lighting.

NOTE: On the project drawings, show location, width, type, and color of the paint markings to be used.

NOTE: When the use of pavement marking materials (epoxy, thermoplastic, and preformed) which perform better than paint is desired for new pavement in Virginia and North Carolina, contact LANTNAVFACENGCOM for sample section.

When applied to pavements with high daily vehicular traffic, High Build Acrylic Coating (HBAC) performs similar to epoxy, thermoplastic, and preformed.

PART 1 GENERAL

1.1 REFERENCES

NOTE: Issue (date) of references included in project specifications need not be more current than provided by the latest guide specification. Use of SpecsIntact automated reference checking is recommended for projects based on older guide specifications.

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D 2240	(2003) Rubber Property - Durometer Hardness
ASTM D 2621	(1987; R 2000) Infrared Identification of Vehicle Solids from Solvent-Reducible Paints
ASTM D 2697	(1986; R 1998) Volume Nonvolatile Matter in Clear or Pigmented Coatings
ASTM D 3335	(1985a; R 1999) Low Concentrations of Lead, Cadmium, and Cobalt in Paint by Atomic Absorption Spectroscopy
ASTM D 3718	(1985a; R 1999) Low Concentrations of Chromium in Paint by Atomic Absorption Spectroscopy
ASTM D 3924	(1980; R 1996) Standard Environment for

Conditioning and Testing Paint, Varnish,
Lacquer, and Related Materials

ASTM D 3960	(2002) Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings
ASTM D 4280	(2003) Extended Life Type, Nonplowable, Raised, Retroreflective Pavement Markers
ASTM D 4541	(2002) Pull-Off Strength of Coatings Using Portable Adhesion Testers
ASTM D 471	(1998e1) Rubber Property - Effect of Liquids
ASTM D 522	(1993a; R 2001) Mandrel Bend Test of Attached Organic Coatings
ASTM D 711	(1989; R 1998) No-Pick-Up Time of Traffic Paint
ASTM D 792	(2000) Density and Specific Gravity (Relative Density) of Plastics by Displacement
ASTM D 823	(1995; R 2001) Producing Films of Uniform Thickness of Paint, Varnish, and Related Products on Test Panels.
ASTM E 28	(1999) Softening Point of Resins Derived from Naval Stores by Ring and Ball Apparatus
ASTM G 53	(1996) Operating Light- and Water-Exposure Apparatus (Fluorescent UV-Condensation Type) for Exposure of Nonmetallic Materials

INTERNATIONAL CONCRETE REPAIR INSTITUTE (ICRI)

ICRI 03732	(1997) Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays
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U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FED-STD-595	(Rev B; Am 1) Colors, Volume 1
FS A-A-2886	(Rev A) Paint, Traffic, Solvent Based
FS TT-B-1325	(Rev C) Beads (Glass Spheres) Retro-Reflective (Metric)
FS TT-P-1952	(Rev D) Paint, Traffic and Airfield Markings, Waterborne

1.2 SUBMITTALS

NOTE: Submittals must be limited to those necessary for adequate quality control. The importance of an item in the project should be one of the primary factors in determining if a submittal for the item should be required.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy projects.

Submittal items not designated with a "G" are considered as being for information only for Army projects and for Contractor Quality Control approval for Navy projects.

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.] [for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Reflective media for airfields

Reflective media for roads and streets

Paints for airfields

Paints for roads and streets

High Build Acrylic Coating (HBAC); G

Thermoplastic compounds and primer

Raised Pavement Markers and Adhesive

SD-06 Test Reports

Reflective media for airfields

Reflective media for roads and streets

Paints for airfields

Paints for roads and streets

High Build Acrylic Coating (HBAC); G

Thermoplastic compounds and primer

Raised Pavement Markers and Adhesive

Report from sampling and testing made in accordance with paragraph entitled "Sampling and Testing."

SD-07 Certificates

Reflective media for airfields

Reflective media for roads and streets

Paints for airfields

Paints for roads and streets

Thermoplastic compounds and primer

Construction equipment list

SD-08 Manufacturer's Instructions

Paints for airfields

Paints for roads and streets

Thermoplastic compounds and primer

Submit manufacturer's Material Safety Data Sheets.

1.3 DELIVERY AND STORAGE

Deliver paints, paint materials and thermoplastic compound materials in original sealed containers that plainly show the designated name, specification number, batch number, color, date of manufacture, manufacturer's directions, and name of manufacturer. Provide storage facilities at the job site for maintaining materials at temperatures recommended by the manufacturer. [Make available paint stored at the project site or segregated at the source for sampling not less than 30 days prior to date of required approval for use to allow sufficient time for testing. Notify the Contracting Officer when paint is available for sampling.]

1.4 WEATHER LIMITATIONS

NOTE: If emergency marking at temperatures from - 1 degrees C 30 degrees F to 5 degrees C 40 degrees F is

required, follow the requirements of Air Force
Engineering Technical Letter (ETL) 97-16 "Pavement
Marking System for Low Temperature Applications."

Apply paint to clean, dry surfaces, and unless otherwise approved, only when air and pavement temperatures are above 5 degrees C 40 degrees F and less than 35 degrees C 95 degrees F for oil-based materials; above 10 degrees C 50 degrees F and less than 43 degrees C 110 degrees F for water-based materials. Maintain paint temperature within these same limits.

1.5 EQUIPMENT

NOTE: Where pavement marking is limited to small street and parking areas, use first paragraph entitled "Paint Applicator."

Machines, tools, and equipment used in the performance of the work shall be approved by the Contracting Officer and maintained in satisfactory operating condition. Submit construction equipment list approval by the Contracting Officer.

1.5.1 Paint Applicator

NOTE: Select the applicable paragraph(s) from the following:

[Provide hand-operated push-type applicator machine of a type commonly used for application of paint to pavement surfaces. Paint applicator machine shall be acceptable for marking small street and parking areas. Applicator machine shall be equipped with the necessary paint tanks and spraying nozzles, and shall be capable of applying paint uniformly at coverage specified.] Applicator for water-based markings shall be equipped with non-stick coated hoses; metal parts in contact with the paint material shall be constructed of grade 302, 304, 316, or equal stainless steel.

[Provide self-propelled or mobile-drawn pneumatic spraying machine with suitable arrangements of atomizing nozzles and controls to obtain the specified results. Provide machine having a speed during application capable of applying the stripe widths indicated at the paint coverage rate specified herein and of even uniform thickness with clear-cut edges.

[Provide equipment used for marking streets and highways capable of placing the prescribed number of lines at a single pass as solid lines, intermittent lines, or a combination of solid and intermittent lines using a maximum of three different colors of paint as specified.] [The equipment for applying the paint for airfield pavements will be a self-propelled or mobile-drawn pneumatic spraying machine with an arrangement of atomizing nozzles capable of applying a width of line at any one time in multiples of 150 mm 6 inches, from 150 to 900 mm 6 to 36 inches.] Provide paint applicator with paint reservoirs or tanks of sufficient capacity and suitable gages to apply paint in accordance with requirements specified. Equip tanks with suitable air-driven mechanical agitators. Equip spray mechanism with quick-action valves conveniently located, and include necessary pressure regulators and gages in full view and reach of the operator. Install paint strainers in paint supply lines to ensure freedom

from residue and foreign matter that may cause malfunction of the spray guns. The paint applicator shall be readily adaptable for attachment of an air-actuated dispenser for the reflective media approved for use. Provide pneumatic spray guns for hand application of paint in areas where the mobile paint applicator cannot be used.] Applicator for water-based markings shall be equipped with non-stick coated hoses; metal parts in contact with the paint material shall be constructed of grade 302, 304, 316, or equal stainless steel.

1.5.2 Reflective Media Dispenser

Attach dispenser for applying the reflective media to the paint dispenser and operate automatically and simultaneously with the paint applicator through the same control mechanism. Use dispenser capable of adjustment and designed to provide uniform flow of reflective media over the full width of the stripe at the rate of coverage specified herein at all operating speeds of the paint applicator to which it is attached.

1.5.3 Thermoplastic Application Equipment

Application equipment shall be mobile and maneuverable to the extent that straight lines can be followed and normal curves can be made in a true arc.

The equipment used for the placement of thermoplastic pavement markings shall be of two general types: mobile applicator and portable applicator.

1.5.3.1 Mobile Application Equipment

The mobile applicator shall be defined as a truck-mounted, self-contained pavement marking machine that is capable of hot applying thermoplastic by either the extrusion or spray method. The mobile unit shall be capable of operating continuously and of installing a minimum of 6000 mm 20,000 lineal feet of longitudinal markings in a 8-hour day. Equip the mobile unit with a melting kettle of such capacity as to hold a minimum of 2700 kg 6000 pounds of molten thermoplastic material. The kettle shall be capable of heating the thermoplastic composition to temperatures of 190 to 218 degrees C 375 to 425 degrees F. The heating mechanism shall be by means of a thermostatically controlled heat transfer liquid. Heating of the composition by direct flame shall not be allowed. Oil and material temperature gages shall be visible at both ends of the kettle. [Equip the mobile unit with a minimum of two extrusion shoes located one on each side of the truck, and shall be capable of marking simultaneous edgeline and centerline stripes. Each extrusion shoe shall be a closed, oil-jacketed unit; shall hold the molten thermoplastic at a temperature of 190 to 218 degrees C 375 to 425 degrees F; and shall be capable of extruding a line of 75 to 200 mm 3 to 8 inches in width; and at a thickness of not less than 3 mm 0.125 inch nor more than 5 mm 0.190 inch, and of generally uniform cross section.] [Equip the mobile unit with a spray gun system. The spray system shall consist of a minimum of four spray guns, located two on each side of the truck, and shall be capable of marking simultaneous edgeline and centerline stripes. Surround the spray system (jacketed) with heating oil so as to maintain the molten thermoplastic at a temperature of 190 to 218 degrees C 375 to 425 degrees F; and shall be capable of spraying a stripe of 75 to 300 mm 3 to 12 inches in width, and in thickness varying from 1.5 to 2.5 mm 0.055 to 0.095 inch, and of generally uniform cross section.]

1.5.3.2 Portable Application Equipment

The portable applicator shall be defined as hand-operated equipment,

specifically designed for placing special markings such as crosswalks, stopbars, legends, arrows, and short lengths of lane, edge and centerlines.

The portable applicator shall be capable of applying thermoplastic pavement markings by the extrusion method. It is intended that the portable applicator will be loaded with hot thermoplastic composition from the melting kettles on the mobile applicator. Equip the portable applicator with all the necessary components, including a materials storage reservoir, bead dispenser, extrusion shoe, and heating accessories, so as to be capable of holding the molten thermoplastic at a temperature of 190 to 218 degrees C 375 to 425 degrees F, of extruding a line of 75 to 300 mm 3 to 12 inches in width, and in thickness of not less than 3 mm nor more than 5 mm 0.125 inch nor more than 0.190 inch and of generally uniform cross section.

PART 2 PRODUCTS

2.1 MATERIALS

NOTE: Use Either FS TT-P-1952, a water-emulsion marking paint, or High Build Acrylic Coating (HBAC) on asphaltic pavement and pavements in areas where air pollution by organic solvents is a problem. On concrete pavements where air pollution by organic solvents is not a problem, FS TT-P-1952 or FS A-A-2886 paint may be used.

HBAC is suitable for reflective and nonreflective use and can be applied at twice the thickness of conventional marking paints. The paint produces upraised markings and is appropriate for use in marking crosswalks, stop legends, railroad crossings, lettering, centerlines, skip lines, and edge lines. HBAC at a thickness beyond that of conventional marking paints is not intended for use on pavements with snowplow use. However, application at standard thickness is acceptable on surfaces employing snowplows.

Use either HBAC or thermoplastic markings to reduce maintenance costs in the desert areas, where painted markings are susceptible to a "sandblasting" effect during high winds.

Provide materials conforming to the requirements specified herein.

NOTE: For LANTNAVFACENGCOM projects only. When the use of pavement marking materials (epoxy, thermoplastic, and preformed) which perform better than paint is desired for new pavement in Virginia and North Carolina, contact LANTNAVFACENGCOM for sample section.

When applied to pavements with high daily vehicular traffic, High Build Acrylic Coating (HBAC) performs

similar to epoxy, thermoplastic, and preformed.

2.1.1.1 Paints for Airfields

[FS A-A-2886] [FS TT-P-1952], color as [indicated] [selected].

2.1.1.2 Paints for Roads and Streets

[FS A-A-2886] [FS TT-P-1952] [High Build Acrylic Coating (HBAC)] , color as [indicated] [selected].

2.1.1.3 Reflective Media for Airfields

FS TT-B-1325, Type I, gradation A.

2.1.1.4 Reflective Media for Roads and Streets

FS TT-B-1325, Type I, Gradation A.

2.1.1.5 Thermoplastic Compounds

The thermoplastic reflectorized pavement marking compound shall be extruded or sprayed in a molten state onto a primed pavement surface. Following a surface application of glass beads and upon cooling to normal pavement temperatures, the marking shall be an adherent reflectorized strip of the specified thickness and width that is capable of resisting deformation by traffic.

2.1.5.1 Composition Requirements

The binder component shall be formulated as a hydrocarbon resin. The pigment, beads and filler shall be uniformly dispersed in the binder resin.

The thermoplastic composition shall be free from all skins, dirt, and foreign objects and shall comply with the following requirements:

<u>Component</u>	<u>Percent by Weight</u>	
	<u>White</u>	<u>Yellow</u>
Binder	17 min	17 min
Titanium dioxide	10 min	-
Glass beads	20 min	20 min
Calcium carbonate and inert fillers	49 min	*
Yellow pigments	-	*

*Amount and type of yellow pigment, calcium carbonate and inert fillers shall be at the option of the manufacturer, providing the other composition requirements of this specification are met.

2.1.5.2 Physical Properties

- Drying time: When installed at 21 degrees C 70 degrees F and in thicknesses between 3 and 5 mm 1/8 and 3/16 inch, the composition shall be completely solid and shall show no damaging effect from traffic after curing 15 minutes.
- Softening point: The composition shall have a softening point of not less than 90 degrees C 194 degrees F when tested in accordance with ASTM E 28.

- c. Specific gravity: The specific gravity of the composition shall be between 1.9 and 2.2 as determined in accordance with ASTM D 792.

2.1.5.3 Primer

- a. Asphalt concrete primer: The primer for asphalt concrete pavements shall be a thermosetting adhesive with a solids content of pigment reinforced synthetic rubber and synthetic plastic resin dissolved or dispersed in a volatile organic solvent. The solids content shall not be less than 10 percent by weight at 21 degrees C 70 degrees F and 60 percent relative humidity. A wet film thickness of 0.13 mm 0.005 inch, plus or minus 0.03 mm 0.001 inch, shall dry to a tack-free condition in less than 5 minutes.
- b. Portland cement concrete primer: The primer for portland cement concrete pavements shall be an epoxy resin primer. The primer shall be of the type recommended by the manufacturer of the thermoplastic composition.

2.1.6 Raised Pavement Markers

Either metallic or nonmetallic markers of the button or prismatic reflector type may be used. Markers shall be of permanent colors as specified for pavement marking, and shall retain the color and brightness under the action of traffic. Button markers shall have a diameter of not less than 100 mm 4 inches. Button markers shall have rounded surfaces presenting a smooth contour to traffic and shall not project more than 3/4 inch above level of pavement. Pavement markers and adhesive epoxy shall conform to ASTM D 4280

2.1.7 High Build Acrylic Coating (HBAC)

Formulate High Build Acrylic Coating (HBAC) to meet the requirements of Table I.

NOTE: Tables are located at the end of Part 3.

2.1.7.1 Preapproved HBAC Vendors and Materials

Table II presents a partial list of HBAC vendors and materials. Up to specifications's date of issue, preapproved materials met specification requirements. It is the user's responsibility to confirm preapproved material formulations have not changed and specification requirements will be met. Other products may meet HBAC requirements.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

NOTE: Newly laid flexible and rigid pavements require aging prior to painting in order to obtain satisfactory paint performance. If practicable, all new pavement surfaces should be at least 30 days old before application of marking materials. When earlier application of paint is necessary because of

operations requirements, the maximum period practicable should be specified.

Removal of rubber is generally accomplished by water blasting. Few approved chemical are effective and sandblasting is not permitted by air pollution regulations at some locations. Mechanical abrasion generally causes damage to the pavement.

Detailed procedures for conducting rubber and paint removal from airfield pavements are contained in Section 02981, "Rubber and Paint Removal from Airfield Pavements."

Existing marking paints with paint build-up greater than 1 mm 40 mils shall be completely removed in accordance with Section 02981, unless crack free and determined sound. When tested for adhesion (ASTM D 4541), a sound marking paint must exhibit greater than 0.97 MPa 140 psi adhesion and/or produce 100 percent cohesive failures within the pavement.

Allow new pavement surfaces to cure for a period of not less than [30] [_____] days before application of marking materials. Thoroughly clean surfaces to be marked before application of the paint. Remove dust, dirt, and other granular surface deposits by sweeping, blowing with compressed air, rinsing with water, or a combination of these methods as required. Remove [rubber deposits,] [existing paint markings,] [residual curing compounds,] and other coatings adhering to the pavement by water blasting. For Portland Cement Concrete pavement, grinding, light shot blasting, and light scarification, to a resulting profile equal to ICRI 03732 CSP 2, CSP 3, and CSP 4, respectively, can be used in addition to water blasting, to either remove existing coatings or for surface preparation on most pavements: shot blasting shall not be used on airfield pavements due to the potential of Foreign Object Damage (FOD) to aircraft. Scrub affected areas, where oil or grease is present on old pavements to be marked, with several applications of trisodium phosphate solution or other approved detergent or degreaser and rinse thoroughly after each application. After cleaning oil-soaked areas, seal with shellac or primer recommended by the manufacturer to prevent bleeding through the new paint. Do not commence painting in any area until pavement surfaces are dry and clean.

3.2 APPLICATION

3.2.1 Rate of Application

NOTE: On new asphaltic surfaces, two coats of marking paint at half the normal application thickness and with a waiting period of two or more weeks between coats may be required to reduce surface cracking, paint curling, and marking paint discoloration.

To reduce FS TT-P-1952 and High Build Acrylic Coating (HBAC) discoloration on uncoated asphaltic wearing surfaces, apply a pre-stripe of the above

paint at 6.13 square meters per liter 250 square feet per gallon. Pre-stripe shall cure to a tack-free state prior to paint application at the specified rate.

The High Build Acrylic Coating (HBAC) can require two or more consecutive coats to meet the specified rate of application when using an airless spray gun.

3.2.1.1 Reflective Markings

Apply paint evenly to the pavement area to be coated at a rate of 2.5 plus or minus 0.10 square meter per liter 105 plus or minus 5 square feet per gallon. [High Build Acrylic Coating (HBAC) at a rate of 1.3 square meters per liter 50 square feet per gallon.] Apply glass spheres uniformly to the wet paint [on airfield pavement at a rate of (1198)] [on road and street pavement at a rate of (719)] plus or minus (60) g of glass spheres per liter [on airfield pavement at a rate of (10)] [on road and street pavement at a rate of (6)] plus or minus (0.5) pounds of glass spheres per gallon.

3.2.1.2 Nonreflective Markings

Apply paint evenly to the pavement surface to be coated at a rate of 2.5 plus or minus 0.10 square meter per liter 105 plus or minus 5 square feet per gallon. [Apply High Build Acrylic Coating (HBAC) at a rate of 1.3 square meters per liter 50 square feet per gallon.]

3.2.1.3 Thermoplastic Compound

After surface preparation has been completed, prime the asphalt or concrete pavement surface with spray equipment. Allow primer materials to "set-up" prior to applying the thermoplastic composition. [Allow the asphalt concrete primer to dry to a tack-free condition, usually occurring in less than 10 minutes.] [Allow the Portland Cement concrete primer to dry in accordance with the thermoplastic manufacturer recommendations. To shorten the curing time of the epoxy resins, an infrared heating device may be used on the concrete primer.] [Apply asphalt concrete primer to all asphalt concrete pavements at a wet film thickness of 0.13 mm 0.005 inch, plus or minus 0.03 mm 0.001 inch 6.5 to 10.0 square meters per liter 265 to 400 square feet per gallon.] [Apply portland cement concrete primer to all concrete pavements (including concrete bridge decks) at a wet film thickness of between 1.0 to 1.3 mm 0.04 to 0.05 inch 7.8 to 10.0 square meters per liter 320 to 400 square feet per gallon.] After the primer has "set-up", apply the thermoplastic at temperatures no lower than 191 degrees C 375 degrees F nor higher than 218 degrees C 425 degrees F at the point of deposition. Immediately after installation of the marking, apply drop-on reflective glass spheres mechanically at the rate of 0.24 kg per square meter one pound per 20 square feet such that the spheres are held by and imbedded in the surface of the molten material. Apply all extruded thermoplastic markings at the specified width and at a thickness of not less than 3 mm 0.125 inch nor more than 5 mm 0.190 inch. Apply all sprayed thermoplastic markings at the specified width and the thickness designated in the contract plans. If the plans do not specify a thickness, apply centerline markings at a wet thickness of 2.3 mm 0.090 inch, plus or minus 0.13 mm 0.005 inch, and edgeline markings at a wet thickness of 1.5 mm 0.060 inch, plus or minus 0.13 mm 0.005 inch.

3.2.2 Painting

Apply paint pneumatically with approved equipment at rate of coverage specified herein. Provide guidelines and templates as necessary to control paint application. Take special precautions in marking numbers, letters, and symbols. Manually paint numbers, letters, and symbols. Sharply outline all edges of markings. The maximum drying time requirements of the paint specifications will be strictly enforced, to prevent undue softening of bitumen, and pickup, displacement, or discoloration by tires of traffic. Discontinue painting operations if there is a deficiency in drying of the markings until cause of the slow drying is determined and corrected.

3.2.3 Reflective Media

Application of reflective media shall immediately follow the application of paint. Accomplish drop-on application of the glass spheres to ensure even distribution at the specified rate of coverage. Should there be malfunction of either paint applicator or reflective media dispenser, discontinue operations until deficiency is corrected.

3.2.4 Thermoplastic Compound

Place thermoplastic pavement markings upon dry pavement. At the time of installation the pavement surface temperature shall be a minimum of 5 degrees C 40 degrees F and rising. Thermoplastics, as placed, shall be free from dirt or tint. Apply all centerline, skipline, edgeline, and other longitudinal type markings with a mobile applicator. Place all special markings, crosswalks, stop bars, legends, arrows, and similar patterns with a portable applicator, using the extrusion method.

3.2.5 Raised Pavement Markers

Prefabricated markers shall be aligned carefully at the required spacing or as directed and permanently fixed in place by means of epoxy adhesives. To ensure good bond, areas where markers will be set shall be thoroughly cleaned by water blasting and use of compressed air prior to applying adhesive.

3.3 FIELD TESTING AND INSPECTION

3.3.1 Sampling and Testing

NOTE: The material specifications do not provide for obtaining certified production data, and the importance of verification testing for each batch where appreciable quantities are involved is emphasized. Only when the factors of time, value of material, and its application versus cost of testing and end use of the material justify a waiver of testing will certification be acceptable.

For projects 3500 square meters 4000 square yards in painted surface area, requirements for Contractor's testing should be used ad the next to last bracketed sentence should be left in. For projects less than 3500 square meters 4000 square yards, delete the next to last sentence and include the last bracketed sentence that will allow for Government testing is

th eContracting Officer deems it necessary.

As soon as the paint [and reflective] [and thermoplastic] materials are available for sampling, obtain by random selection from the sealed containers, two quart samples of each batch in the presence of the Contracting Officer. Accomplish adequate mixing prior to sampling to ensure a uniform, representative sample. A batch is defined as that quantity of material processed by the manufacturer at one time and identified by number on the label. Clearly identify samples by designated name, specification number, batch number, project contract number, intended use, and quantity involved. [Test samples by an approved laboratory. If a sample fails to meet specification, replace the material in the area represented by the samples and retest the replacement material as specified above. Submit copy of the test results to the Contracting Officer. Include in the report of test results a listing of any specification requirements not verified by the test laboratory.] [At the discretion of the Contracting Officer, samples provided may be tested by the Government for verification.]

3.3.2 Inspection

NOTE: The material specifications do not provide for obtaining certified production data, and the importance of verification testing for each batch where appreciable quantities are involved is emphasized. Only when the factors of time, value of material, and its application versus cost of testing and end use of the material justify a waiver of testing will certification be acceptable.

For projects 3500 square meters 4000 square yards in painted surface area, requirements for Contractor's testing should be used. For small projects, use Government test option.

Examine material at the job site to determine that it is the material referenced in the report of test results or certificate of compliance. A certificate of compliance shall be accompanied by test results substantiating conformance to the specified requirements.

3.3.2.1 Surface Preparations and Application Procedures

Surface preparations and application procedures will be examined by the Contracting Officer to determine conformance with the requirements specified. Approve each separate operation prior to initiation of subsequent operations.

3.4 TRAFFIC CONTROL AND PROTECTION

Place warning signs near the beginning of the work site and well ahead of the work site for alerting approaching traffic from both directions. Place small markers along newly painted lines to control traffic and prevent damage to newly painted surfaces. Mark painting equipment with large warning signs indicating slow-moving painting equipment in operation. Do not use foil-backed material for temporary pavement marking because of its potential to conduct electricity during accidents involving downed power

lines.

TABLE I
REQUIREMENTS FOR HIGH BUILD ACRYLIC COATINGS (HBAC)

Test	Minimum Requirement (and Maximum where indicated)
Resin System (ASTM D 2621)	Waterborne 100% Acrylic
Percent Volume Solids (ASTM D 2697)	58%
Volatile Organic Compound, max. (ASTM D 3960)	150 g/l 1.25 lbs/gal
White (FED-STD-595)	37925
Yellow (FED-STD-595)	33538
Shore D Hardness (ASTM D 2240)	45
1/8 inch Mandrel Bend @ 5 mils Dry Film Thickness (DFT, one-week cure (ASTM D 522, Method B)	No visual defects at bend (Conditions @ ASTM D 3924)
Adhesion to Concrete and Asphaltic Pavements (ASTM D 4541)	0.97 MPa 140 psi or 100% cohesive failure in pavement
Accelerated Weathering, Yellow, 2500 Hours UV Exposure (ASTM G 53: see note 1)	Max. color loss to 33655 (FED-STD-595)
Water Absorption @ 168 Hours Immersion Tap Water (ASTM D 471)	9.0% max. weight increase (conditions @ ASTM D 3924)
Application @ 1650 microns 65 mils Wet, One Coat, One-week Cure, (see note 2)	No visual cracking or curling (conditions @ ASTM D 3924)
No Pick-Up @ 630 microns 25 mils (ASTM D 711)	Wet 10 minutes max.
Lead (ASTM D 3335)	0.06% max.
Cadmium (ASTM D 3335)	0.06% max.
Chromium (ASTM D 3718)	0.00%

Notes:

(1) Properly mix and apply yellow paint at 250 microns +/- 50 microns 10 mils +/- 2 mils DFT over a suitably sized, clean aluminum substrate (ASTM D 823), and cure for a minimum of 48 hours: four individual yellow samples shall be prepared. Expose three samples to continuous Ultraviolet (UV) light for 2500 hours, without cycles condensation, in accordance to ASTM G 53: UVA-340 lamps shall be used in the testing apparatus. Following exposure, compare the three exposed samples to the "one" non-exposed sample using FED-STD-595 colors 33538 and 33655 as visual references: evaluate exposed samples for degree of visual color loss. Yellow paint shall receive a passing rating if each exposed sample appears equivalent to the non-exposed

TABLE I

REQUIREMENTS FOR HIGH BUILD ACRYLIC COATINGS (HBAC)

sample, and in addition, displays color loss no greater than FED-STD-595 color 33655.

(2) Using double-stick, foam mounting tape (or equal) with a nominal thickness of 1625 microns 65 mils, apply a rectangular mold with inner dimensions of 7.6 cm by 25.5 cm 3 in by 10 in to a clean aluminum sample approximately sized at 15 cm by 30 cm by 0.30 cm 6 in by 12 in by 1/8 in. Do not remove the tape's plastic backing. Mix and apply excess paint into mold.

Remove excess paint, by squeegee or other appropriate draw down technique, to a uniform thickness equal to the tape's height. Paint application and draw down shall be performed within a period of no more than 60 seconds.

Approximately one to two minutes following the draw down, remove tape from sample and allow coating to cure for a minimum period of one week ASTM D 3924.

Using a micrometer or other appropriate device, measure cured coating thickness (less sample thickness) to confirm resulting coating application was at or above 950 microns 38 mils DFT. Inspect coating for visual signs of cracking and curling. Following a one week cure, coating shall receive a passing rating if applied greater than 950 microns 38 mils DFT and visually free of both cracking and curling.

TABLE II
PREAPPROVED HBACs

Manufacturer	Products
TMT-Pathway 1021 N. Mission Road Los Angeles, CA 90033 (800) 338-7680	Legend Build, #2712A9, White Legend Build, #2713A9, Yellow
Pervo Paints 6624 Stanford Ave. Los Angeles, CA 90001 (323) 758-1147	Pervo 6050, White Pervo 6053, Yellow
Vogel Traffic Services 1920 Albany Place South PO Box 140 Orange City, IA 51041 (712) 737-4016	UC-1516, White UC-3588, Yellow

-- End of Section --