ENNIS-FLINT
A Traffic Safety Solutions Company

APRIL 2013

Meeting FAA Marking Standards:

Achieving maximum value and optimal performance through the use of preformed thermoplastic airfield pavement markings

AC 150/5370-10F

Challenge

FAA requirements for multi-colored surface signage and delineation markings presents installation and maintenance concerns using traditional application methods and materials

On June 6, 2008, the FAA issued Change 2 to AC 150/5340-1J which clarifies the requirement for enhanced taxiway centerline markings and surface painted holding position markings at Part 139 airports. Individuals responsible for the installation and maintenance of pavement markings must find balance among safety, value and product performance. The key concerns include but are not limited to:

- Runway closures due to frequency of repainting
- Costly mobilization
- Life-cycle costs
- Safety management
- Durability
- Workmanship and quality control

Solution

AirMark® provides a sensible solution and complements an airfield pavement marking program

AirMark® is a durable preformed thermoplastic pavement marking material engineered with the objectives of safety, durability, workmanship and economy. Suited for use on taxiways, ramps, aprons, gates, and vehicle roadways as well as other areas on the airside excluding runways, the advantages and value of AirMark® are pronounced in the application of multi-colored markings that are typically time and labor intensive when using other marking materials.

The purpose of this paper is to introduce AirMark® preformed thermoplastic as an FAA-tested and recommended alternative airfield pavement marking material as well as to emphasize three critical aspects of safety management that should not be overlooked--*Bond, UV Resistance, and Retroreflectivity.*

Some of the information contained in this paper is derived from the FAA evaluation following extensive one-year test applications and field applications of AirMark as well as references from the *Airfield Marking Handbook*, an Innovative Pavement Research Foundation (IPRF) Research Report funded by the FAA.

What is Preformed Thermoplastic?

Introduced to the United States in 1987 by Flint Trading, Inc., preformed thermoplastic is a pavement marking material that is applied to asphalt or concrete using a propane heat torch and/or a large heater. It is used primarily because of its durability and cost-effective service life. Pre-cut and ready to position onto the pavement surface, the most common applications are found on public streets and highways at intersections as stop lines, legends, arrows, and crosswalks. Ennis-Flint's preformed thermoplastic product, AirMark®, is formulated specifically for use on airfields.

AirMark® applications using a large heater and propane heat torch.

How Does Preformed Thermoplastic Really Work?

A low viscosity melt phase from adequate heat is required for a proper bond between the pavement marking material and the pavement.

In order to have good long term performance, a pavement marking must be well bonded with the pavement surface. For a preformed thermoplastic pavement marking material, this means that enough heat needs to be applied to the marking in to develop a low viscosity melt phase at the interface between the pavement marking material and the pavement surface. Once this low viscosity melt phase is achieved, the marking "wets*" the pavement surface and then cools, achieving an adhesive bond. One may compare this method of application with hot-applied thermoplastic, which is typically sprayed or extruded in this low viscosity melt phase or with paint that contains solvent in order to achieve a low viscosity and bond with the pavement surface. Most pavement marking materials can only achieve bond if the viscosity of the material is low enough to "wet" the pavement surface.

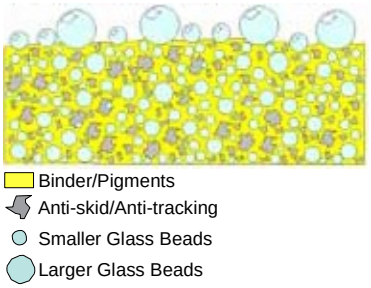
Close-up view of factory-applied surface elements that are partially embedded at time of manufacture. Following proper application of material, these surface elements become optimally embedded in order to maximize anti-skid and retroreflective properties.

While drop-on elements (glass beads and/or anti-skid materials) need to be applied to paint or hot applied thermoplastic during field application as a separate process, preformed thermoplastic pavement marking materials typically have glass beads and/or anti-skid materials that are partially embedded during the controlled manufacturing process. This process makes these materials convenient to use because during field application these factory-applied surface elements become optimally embedded into the thermoplastic in order to maximize anti-skid and/or retroreflective properties.

Provided the applicator properly follows the manufacturer's application instructions for the marking, the process of bonding to the pavement and achieving optimal retroreflective and anti-skid properties are achieved at the same time.

* Wet (wetting) is the ability of a liquid (not water) to maintain contact with a solid surface, resulting from intermolecular interactions when the two are brought together.

Composition of Preformed Thermoplastic Supports Performance



Preformed thermoplastic consists of a homogenous mixture of high quality polymeric thermoplastic binders, pigments, fillers, and glass beads which have been factory produced as a finished product with a uniform thickness. The specific composition combined with the proper application method leads to optimal field performance especially as it relates to critical areas of safety management program aimed at preventing runway incursions and vehicle pedestrian deviations.

Bond

As stated in the Airfield Marking Handbook, "*The pavement surface must be prepared properly prior to applying markings. Surface preparation is the cleaning and removal of anything that would reduce the bond between the newly applied material and the surface.*" This is a key process that is often overlooked.

The ability for AirMark® to bond to the pavement surface is based on the thermal properties of the binder and the surface along with the porosity of the surface. The binders provide the cohesive strength of the marking material and adhesive bonding with the substrate. In addition, the use of AirMark® Sealer prior to application enhances the mechanical bond because the sealer penetrates into the substrate, particularly through laitance if present on concrete, and allows the marking to be anchored to the pavement surface. Yet, AirMark® can be easily removed, as necessary, with waterblasting.

Retroreflectivity

Supplied at a uniform thickness, AirMark® contains factory-applied surface glass beads as well as beads intermixed throughout the material. As the marking wears, new glass beads are exposed. Therefore, the material, when applied in accordance with the application instructions, demonstrates a uniform level of sufficient retroreflection (nighttime visibility)--a critical factor for pilots and ground support drivers who expect better visual acquisition of the markings during nighttime operations.

UV Resistance

AirMark® maintains its colors because of the highest quality of pigments and UV inhibitors used during time of manufacture. Gradual wear exposes new pigments to extend the life of the marking. Due to the fast fading nature of red paint, airport operators will typically plan to repaint Surface Painted Holding Position Signs on at least an annual basis, but more often twice per year. With AirMark®, the life of this marking type can be extended up to 8 to 12 times longer than paint.

FAA Evaluation Summary of AirMark®

■ AirMark® was thoroughly tested and evaluated by the FAA in two locations:
1. William J. Hughes Technical Center for 1 year starting June 2006
   - material applied to PCC and HMA surfaces
   - marking types were white, yellow, black, and red stripes and aircraft parking designator markings
2. Newark Liberty International Airport for 1 year starting August 2006
   - material applied to PCC surface on taxiway with approximately 700 aircraft movements per day
   - marking types were white, red, and black Surface Holding Position Sign (4R-22L) and one solid yellow line of the Runway Holding Position Marking

■ Scope:
To determine if preformed thermoplastic is as effective as current paints in retroreflectivity, chromaticity, friction properties, and adherence to pavement surfaces and if it can be added as an alternative to paint materials to the FAA AC 150/5370-10B regarding standards for runway and taxiway painting.

■ Data Collection Summary:
- Chromaticity: acceptable when compared with the CIE standard illumination D65 chart and color chips of the Federal Standard 595B. None of the colors examined faded out of tolerance.
- Retroreflectivity: white, yellow and red materials were above the minimum levels of retroreflectivity as set by the FAA.
- Adherence: the tensile strength of the bond between the preformed thermoplastic marking material on HMA and PCC was acceptable following proper surface preparation
- Friction: preformed thermoplastic is best suited for taxiways and aprons

■ Evaluation Result:
Preformed thermoplastic marking material proved suitable for use on taxiway and apron markings and, therefore, is recommended for these applications.

Steps to FAA Approval for Preformed Thermoplastic

■ June 2008: the draft AC was published

■ In 2009: over 20 airports applied for a Modification to Standard in order to use AirMark® pavement markings while the inclusion of preformed thermoplastic material in the AC was pending. Seven out of nine FAA regions include airports that have used AirMark® during this time.

■ November 2009: AC 150/5370-10E published to include preformed thermoplastic under Item P-620.

AirMark® by Ennis-Flint

Durability & Life Cycle

Key Considerations for Using AirMark

In August 2006, a Surface Holding Position Marking was applied using AirMark® preformed thermoplastic and waterborne paint for a side-by-side comparison in one of the harshest areas on the airfield at Newark Liberty International Airport (EWR). During the 1-year test comparison, the white waterborne paint had to be reapplied after 9 months and the yellow waterborne paint had to be reapplied after 11 months, both due to low retroreflectivity.

In August 2007, at the end of the one-year FAA field test and without requiring any maintenance, the AirMark® retroreflectivity reading for white material was 193 mcd/m^2/lx. AirMark® contains factory-applied surface glass beads as well as beads intermixed throughout the material so that as the marking wears, new beads are exposed.

At 80 months after application, this same AirMark® Surface Holding Position Marking is still in service without any foreseeable requirement for reapplication. During this same time frame, the original AirMark® marking has withstood over 100 snow alerts resulting in hundreds of broom and plow passes. This performance is consistent with Ennis-Flint's experience with preformed thermoplastic on roadways and is supportive of an expected life cycle of 8 to 12 times longer than paint. In addition, the real value of AirMark® is recognized when keeping the following facts in mind:

- the homogeneous composition of AirMark® supports long-term performance regarding bond, retroreflectivity, and UV resistance
- mobilization costs are reduced because crews do not have to reapply as often as painting
- runway closures are minimized because of decreased maintenance requirements
- installation method has significant advantages especially in application of multi-color markings that are typically labor intensive; more markings can be applied during the time of runway closure as compared to paint

Waterborne paint application following 6 months of FAA testing at EWR

AirMark® preformed thermoplastic application following 6 months of FAA testing at EWR

AirMark® shown at 80 months at EWR

Ease of Application

AirMark® is available in rolls or sheets of interconnected material for simple layout prior to heating with a single pass from a large heater. This eliminates the cumbersome painting process of masking different colors and allowing for drying times between the application of each color. AirMark® can be opened to traffic within as little as 15 minutes following application depending upon current conditions. Set-up time can be accelerated with dispensing cool water over the marking. There are no minimum pavement or ambient temperature requirements prior to application.

Safety

According to the NTSB Accident Report NTSB/AAR-07/05, "*From a human factors standpoint, surface painted holding position signs provide pilots with an unambiguous cue of their position on the airport surface. The central location of these position signs (adjacent to the taxiway centerline) increases their conspicuity, providing a critical redundancy to existing signage.*"

Regardless of the marking type, all pavement markings are essential elements of a Safety Management System because they provide traffic guidance on all areas of an airfield. Performance requirements are necessary to ensure proper application and maintenance for the safety of pilots and individuals providing ground support and maintenance. Because of the stringent ISO-certified and controlled manufacturing process, each AirMark® pavement marking is engineered according to specification to meet safety requirements.

As stated in the Airfield Marking Handbook, "*When quality is built into the marking, safety is enhanced, and the life cycle cost benefit is significantly enhanced.*"