

TECHNICAL SUMMARY

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Pavement Markings: Stain Resistant Additive Improves Paint Performance, Bead Loss Reduced in Thicker Paint

Staining of airfield markings is a safety problem. On airport pavement white paint markings indicate that the pavement is a runway; yellow paint indicates the pavement is a taxiway or aircraft parking apron. Maintaining this difference in color is critical for the safety of all airport users. Iron, which is present in the sand and stone (aggregate) within the bituminous pavement, when exposed to air and water stains the airfield paint a yellowish-brown shade, which is particularly noticeable on the white paint. This staining affects compliance with the color standards required by the Federal Aviation Administration (FAA) and Department of Defense (DoD) and requires airport sponsors to expend resources to repaint the runway.

Iron staining has occurred within six months to a year of paint application at many New Hampshire airports in fact this occurs throughout the eastern US as far west as MN. As funds are available, airports correct the staining by repainting or a combination of removal and repainting. Sometimes it may be years before an airfield repainting project can be funded. This study observed various paint types with and without stain and rust inhibitors over a 24-month period with the goal of extending the life of the paint.

Glass beads installed with the paint improve visibility in low lighting. The larger bead increases the conspicuity of the paint and thereby increases safety. However, larger beads require thicker paint to achieve the proper embedment. The study observed the bead retention and reflectivity of various paint types and bead sizes over a 24-month period.

Stain resistant additive incorporated into the FAA specification P-620 Type II or III paint kept the runway pavement markings whiter over the 24-month study as compared to paint with rust inhibitor or no additive.



White runway paint turns yellowish color in as soon as 6 months. Original white color panel next to the field applied stained paint is shown.

What Was Our Goal?

Investigators conducted field trials of various paint types and thickness on bare and seal-coated surfaces. The trials evaluated the paint discoloration and bead performance. The main goal was to determine if the use of additives in the paint or the paint application on a seal coat surface reduced the paint staining. A secondary goal was to evaluate the bead performance in paint applied thicker than the FAA standard.

What Did We Do?

Working closely with NHDOT's Bureau of Materials and Research we identified five test areas for painting at Laconia Municipal Airport. Four test areas included various FAA P-620 specification paint and bead types placed on bare bituminous pavements. The fifth area painted over the FAA P-608 seal coat. The test areas were 200 feet to 1,050 feet in length. The striated runway edge markings were selected as the test areas.

Paint variants included the FAA P-620 paint Types II and III with and without additives. The variants were selected to determine which type of paint resisted discoloration. A stain resistant additive was included in two areas. A rust inhibitor additive was included in a third area. The remaining two areas included the FAA standard paint on unsealed and sealed pavements, respectively.

The smaller Type I bead and the larger Type III beads with various paint thickness were applied. The intent of the bead combinations was to observe the bead performance: reflectivity and loss of beads. One area used a larger Type III bead in the lowest FAA application thickness to challenge the retention of the beads with a lower depth of embedment. A second area installed the Type III bead in an application thicker than the FAA specifies to evaluate the beads with a deeper embedment in thicker paint. The three remaining areas utilized the FAA standard application thicknesses.

The paint was applied in the summer and fall of 2017. Starting in December 2017 and ending in September 2019, the areas were inspected for paint discoloration, "bottom-up" rust spot stains, reflectivity and bead loss. Eight site visits were made approximately every 3 months over the 24-month study period to inspect the test areas.



Paint color comparison made with original white control panels placed next to field stained paint.

Bottom-up Rust Stain Spots were counted within the study areas.

Reflectivity of paint and beads were measured in the study areas.

Magnified images of each study area were imported into CAD and the loss of beads were counted. Red dots are bead losses.



What Did We Learn?

The stain resistant additive incorporated into the FAA specification P-620 Type II or III paint kept the runway pavement markings whiter over the study period as compared to paint with rust inhibitor or no additive. This appears to be due to the reduced porosity of the stain resistant paint. The reduced paint pores lowered the potential for iron to cling to the stain resistant paint during periods of stormwater sheet flow over the paint.

The FAA specification P-608 seal coat under the paint reduced the staining of the paint. Additionally, the black background provided by the seal coat provided a contrast compared to the white paint. This contrast aided in the visibility of the paint on the seal coat. The study found the paint on the seal coat markings cracked more than the paint on bare pavement.

The rust inhibitor additive did not stop the surface rust discoloration but did limit the number of "bottom-up" rust stain spots.

Reflectivity readings taken with a retroreflector remained at or above the FAA 'at installation' requirement after two years of observations.

The reflectivity of the Type I and III beads applied in paints at 115 SF/GAL performed slightly better than Type III beads in thicker paint.

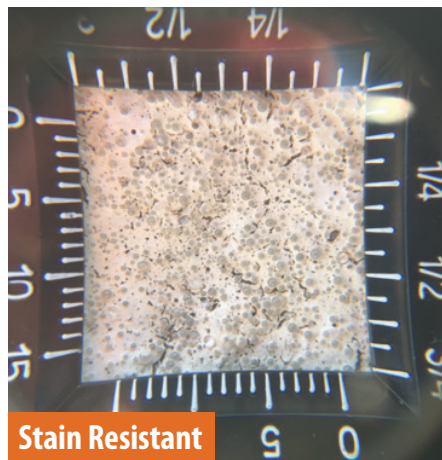
Bead loss was approximately equal for all the samples at the end of the two-year study. The thicker the paint, the higher the bead retention.

What's Next?

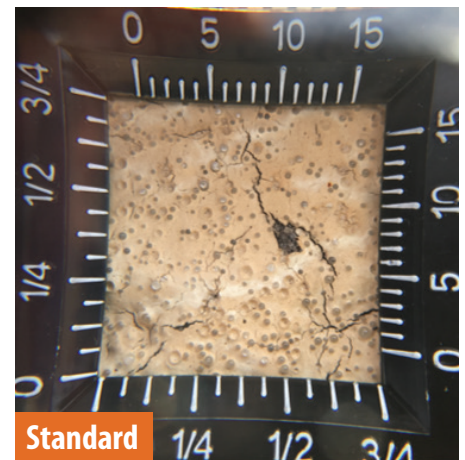
Additional studies of paint additives, bead type and thicknesses would be useful to the FAA and NHDOT in supporting the results of the study.

Type II paint with stain resistant additive (IISR) and Type III beads remains whiter after 24 months compared to the standard FAA control paint (above).

Magnified images of paint after 24 months indicates paint with a stain resistant and thickness 20% greater than the FAA standard (on left) maintained its color and had fewer bead losses compared to the standard FAA paint and thickness application (on right).



Stain Resistant



Standard