

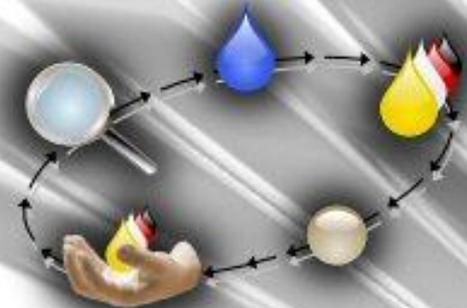
Effective Airfield Markings

Workshop on Air Navigation Visual Aids New Technologies

May 8, 2012

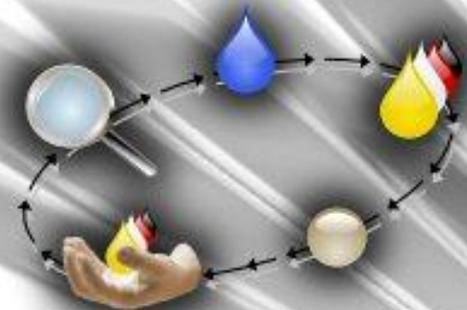
Lima, Peru

Donna Speidel, President
Sightline, LC
Airport Marking Consultants



Overview

- ➔ Markings – what's usually noticed.
- ➔ Purpose of airfield markings.
- ➔ Airfield Marking Handbook.
- ➔ Myths about airfield markings.
- ➔ Challenges with markings on airfields.
- ➔ How do you know they're *effective*?
- ➔ Assessing your markings.

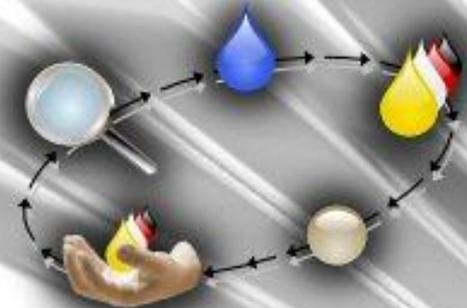


Standards, Functions, and Elements of Airfield Markings

ICAO, International Standards and Recommended Practices,
AERODROMES, Annex 14, Volume I, Third Edition, July 1999

Federal Aviation Administration (U.S.)
AC 150/5340-1K

Describes **WHAT** the markings are,
WHEN you're supposed to use them
and **WHERE** they belong.



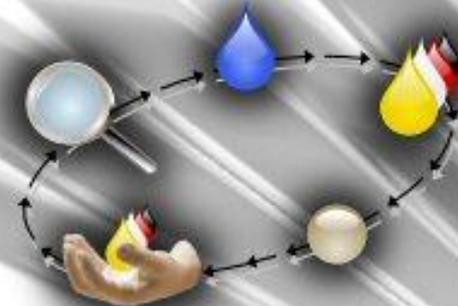
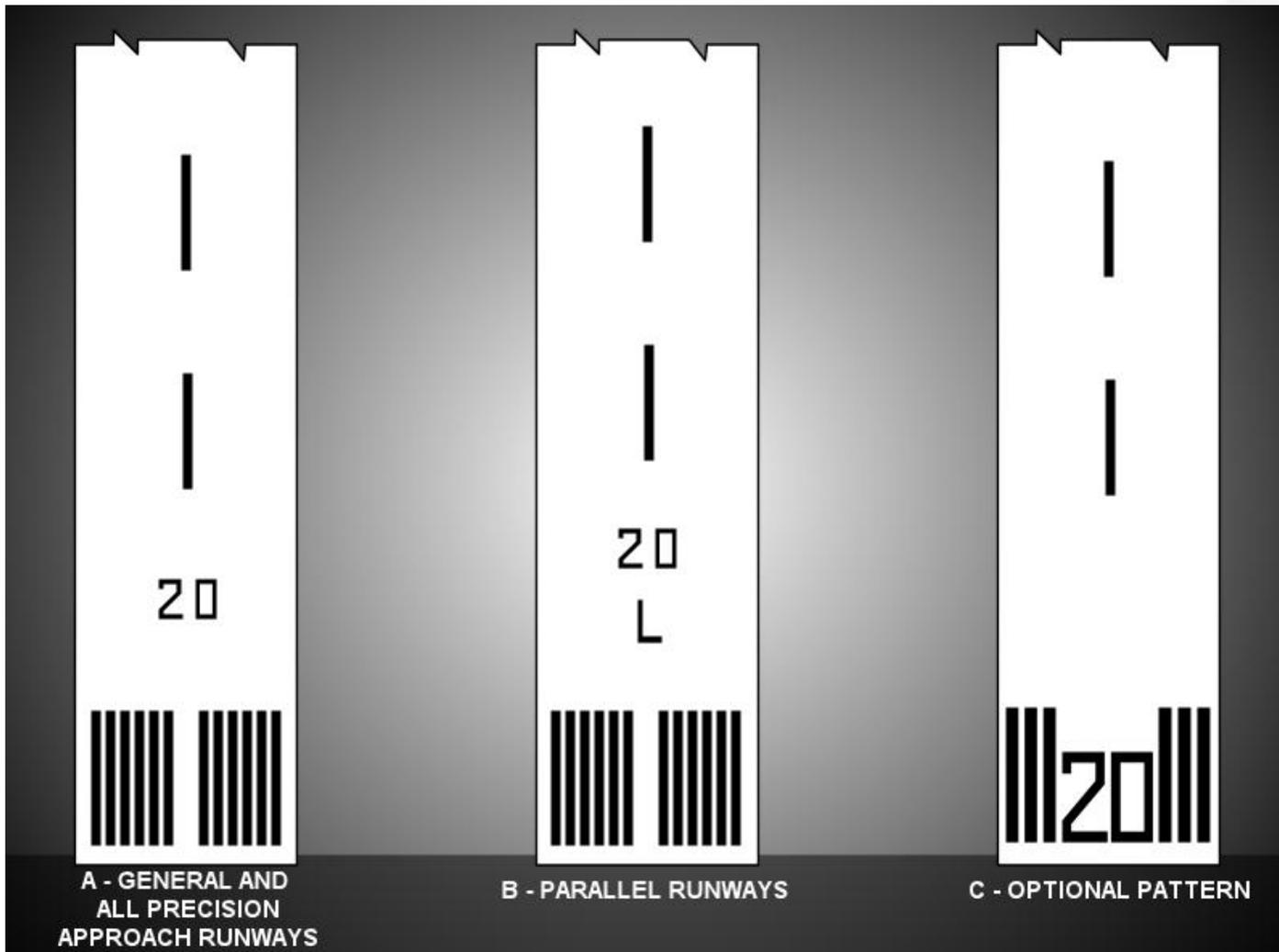


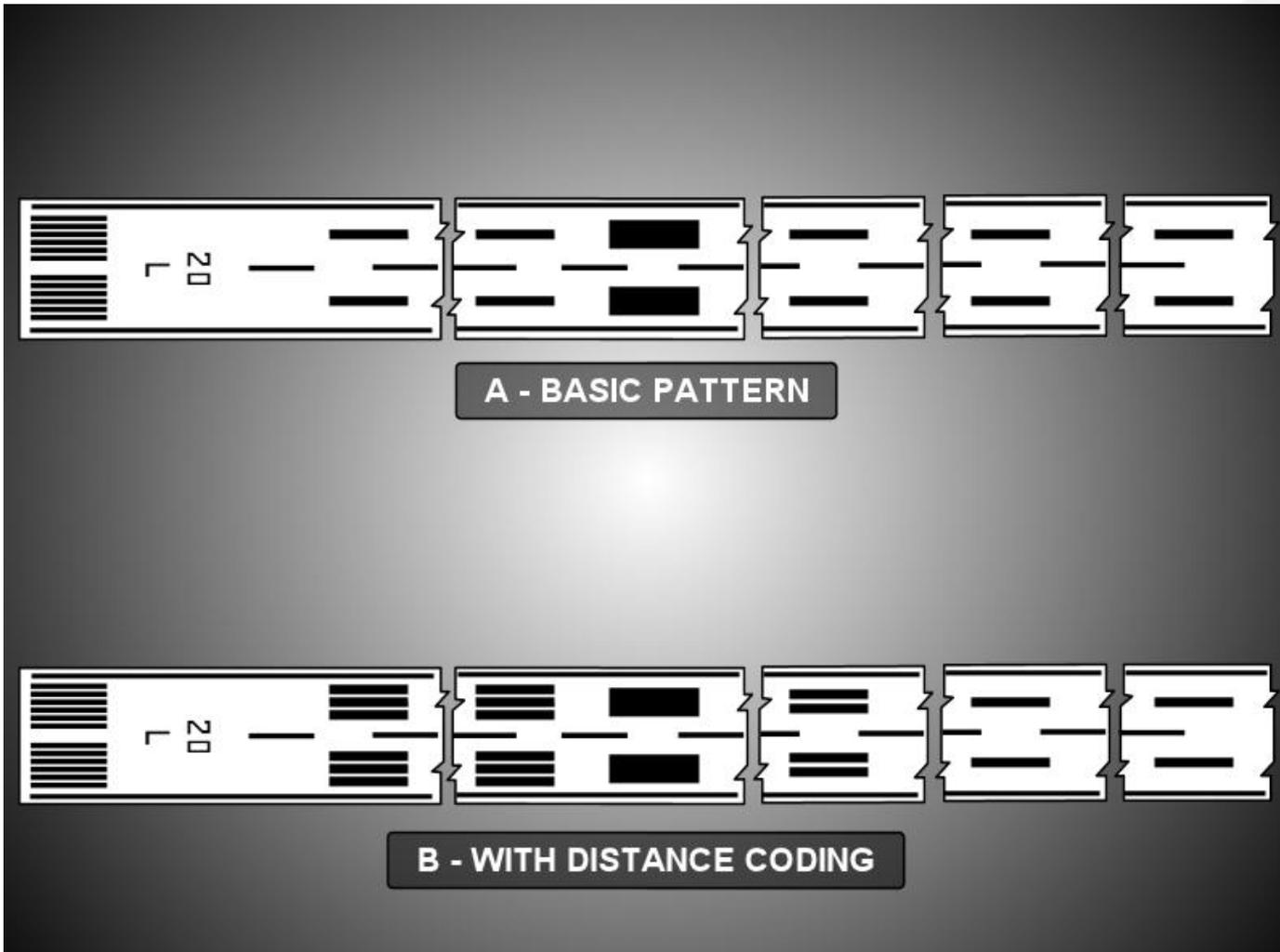




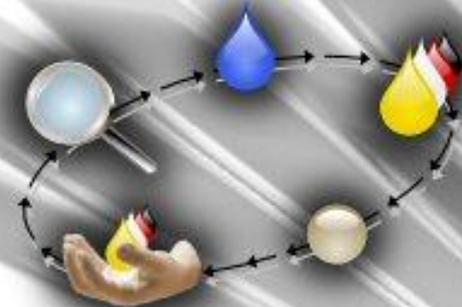








Precision runways



Markings Matter

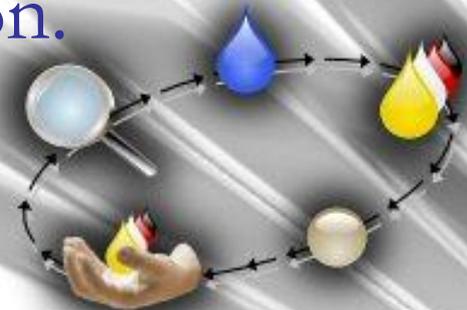
. . . but are taken for granted

→ Airport Marking Importance

- Guide the pilot to and from the runway.
- Provide situational awareness.
- Provide the only continuous visual aid.
- Promote safety.

Lack of clear, *effective* markings can:

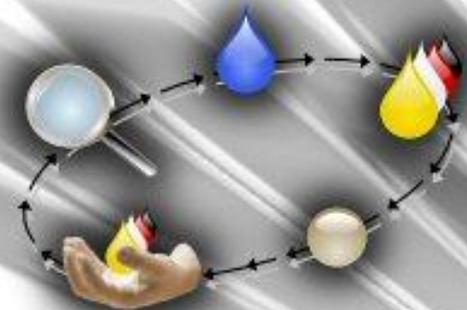
- ✓ Cause confusion.
- ✓ Contribute to an incursion.
- ✓ Reduce safety.



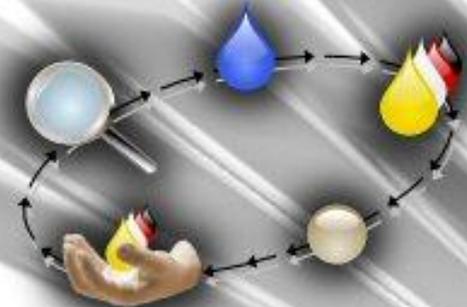
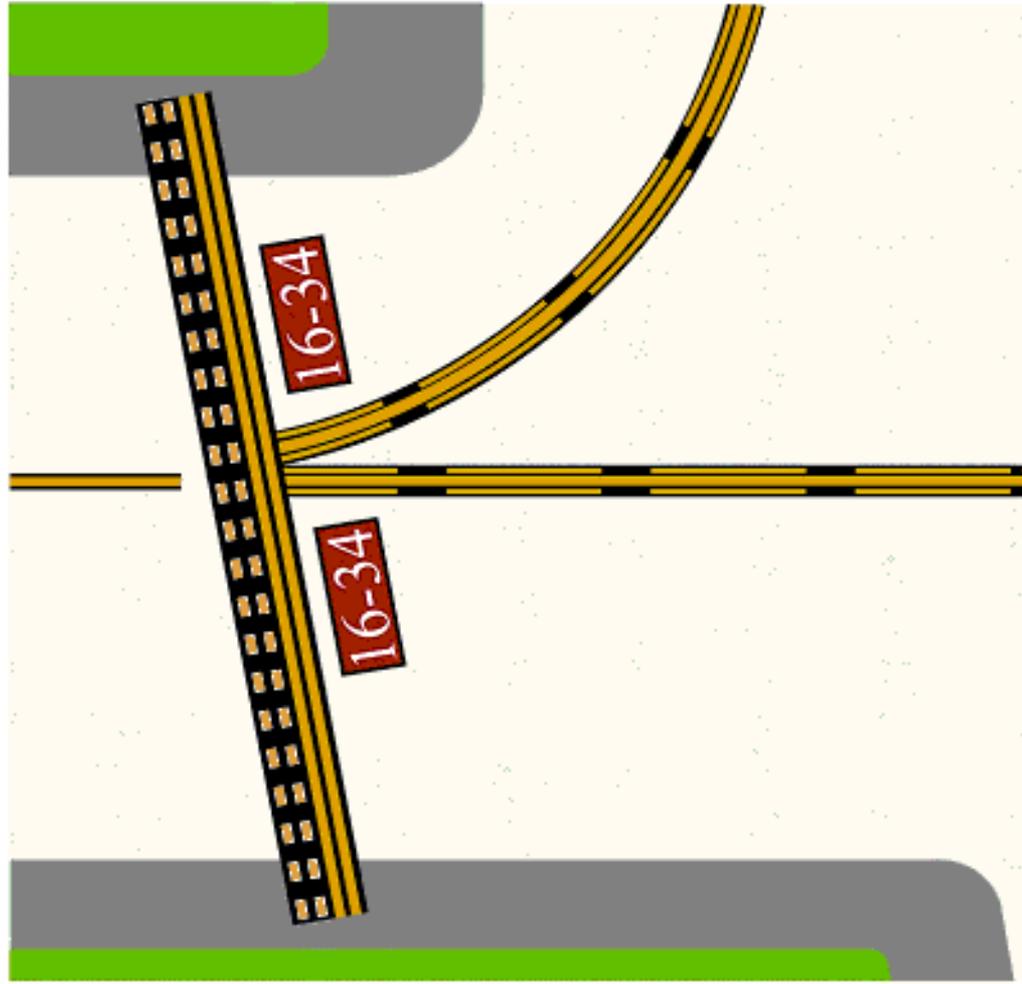
The most important aspect of markings is VISIBILITY.

➔ Markings should:

- ✓ Be conspicuous under low visibility conditions.
- ✓ Be highly visible, especially during darkness.
- ✓ Reduce confusion for pilots.
- ✓ Enhance safety.



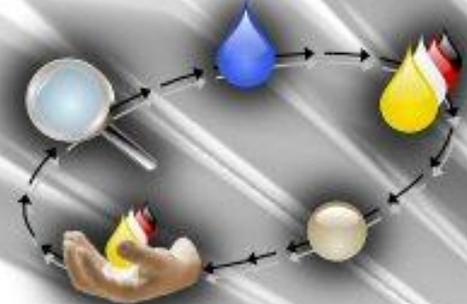
Enhanced Taxiway Marking Elements

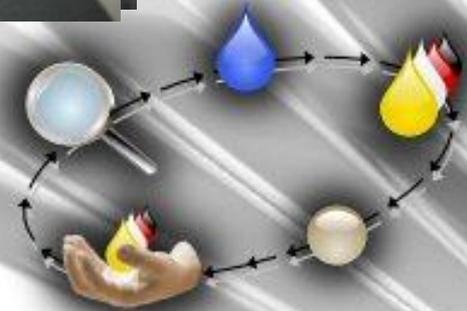


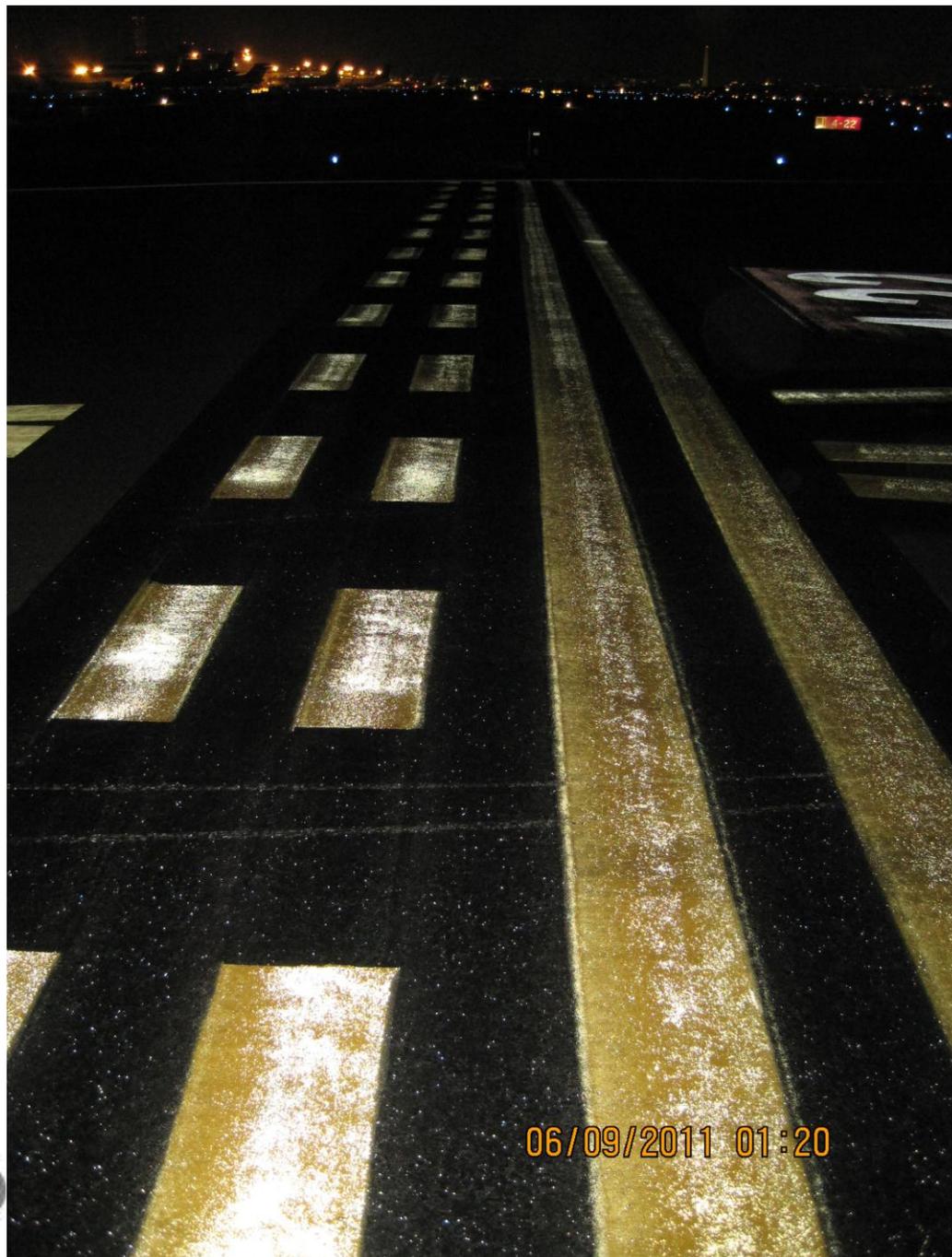
Visibility of Markings

➔ Use of glass beads and black borders

“Markings that cannot be seen [at night] by pilots and others operating on marked surfaces are useless.”

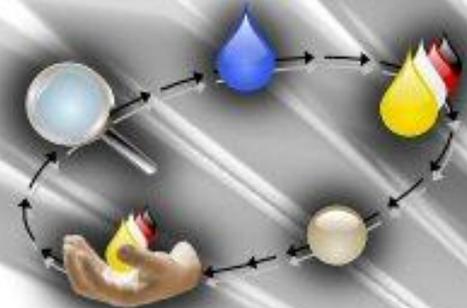






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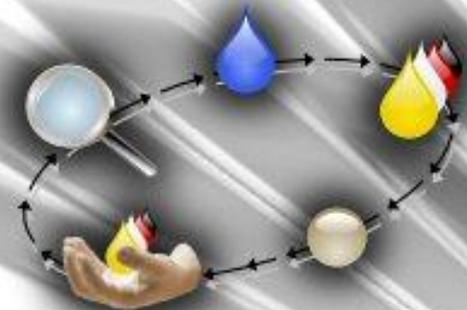


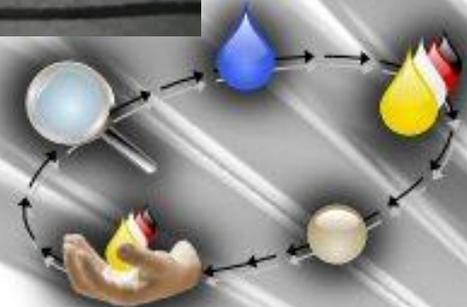


Visibility of Markings

Quality Application

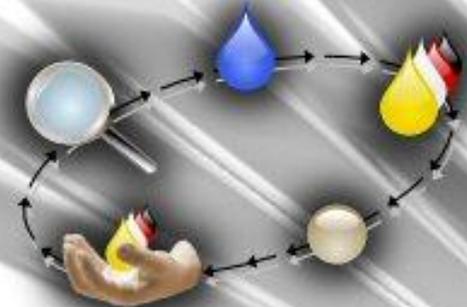
All the efforts to increase visibility with black borders, glass beads and new designs are futile if markings are not applied well.



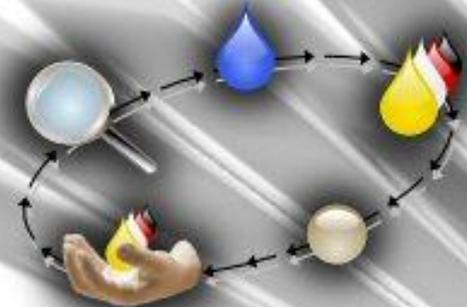
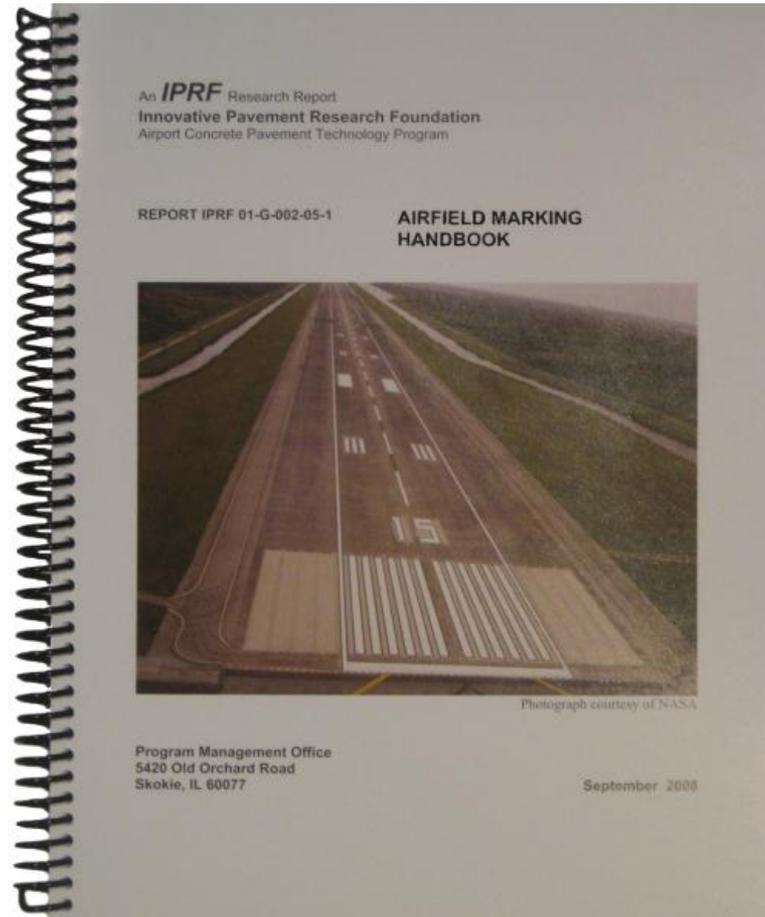




Markings should be as visible during darkness as they are during daylight.

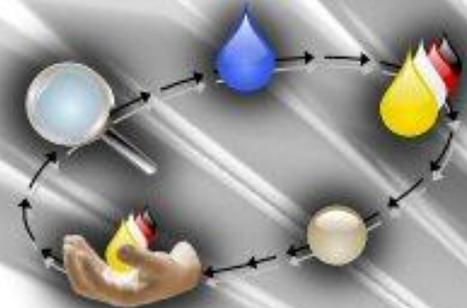


Sightline, LC (Airport Marking Consultants) is the primary author of the *Airfield Marking Handbook*.



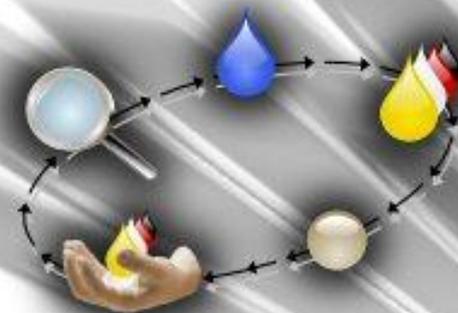
Objectives of the handbook

1. Identify why markings are a challenge.
2. How can markings last longer?
3. What is an *effective* marking?
4. What are good marking practices?



Myths about Airfield Markings

- ➔ Markings are easy to apply, training isn't necessary.
- ➔ A “typical” marking installation is good enough.
- ➔ Airfield markings provide the same level of safety to pilots as highway markings do for drivers.
- ➔ If the ICAO/FAA inspection cited no discrepancies, the markings are effective.
- ➔ Marking maintenance is needed at least every year, especially in winter environments.
- ➔ Waterborne paint doesn't last.
 - ➔ Painting over old paint is okay; there is no time to clean them.



VISUAL AIDS

Signs

If a sign is unlit or broken, it gets replaced.

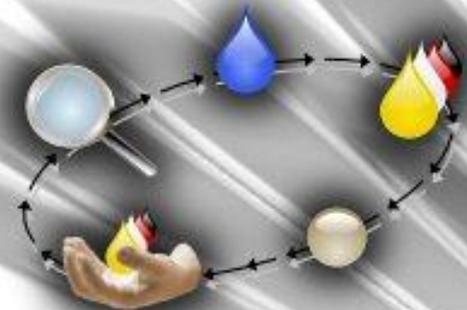
Lights

If a taxiway light is malfunctioning, it gets fixed.

Markings

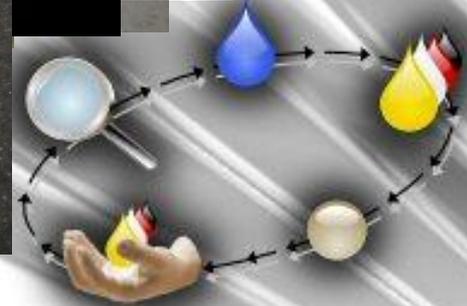
But how do you know when the markings are

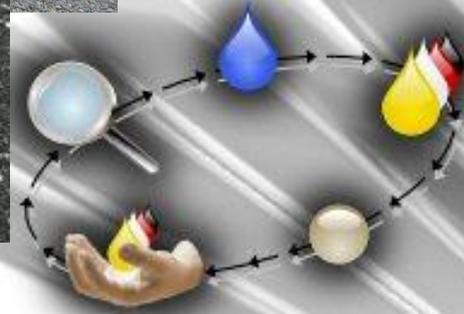
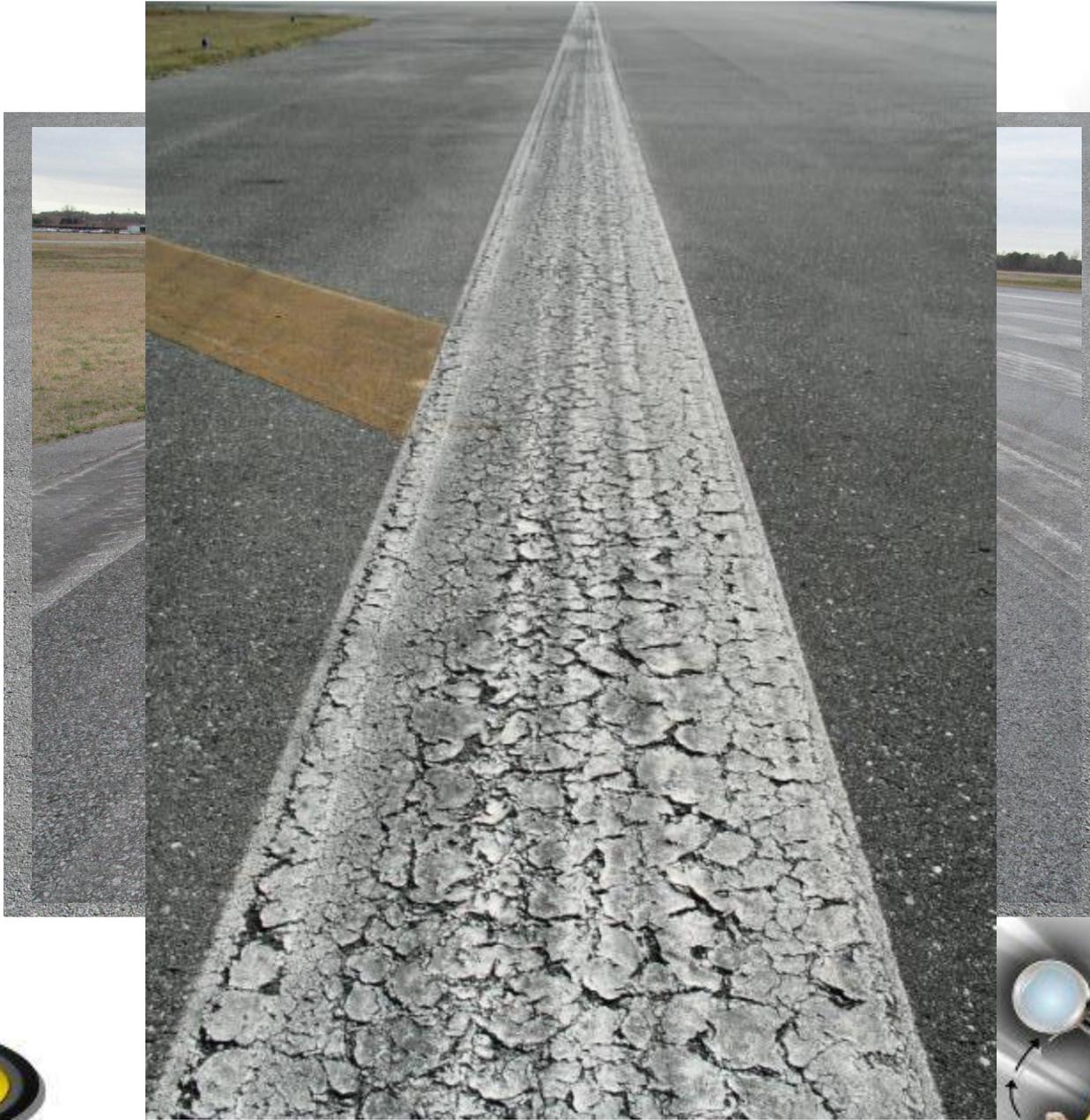
“broken”?





WWW.SHIPMENTOFFAIL.COM

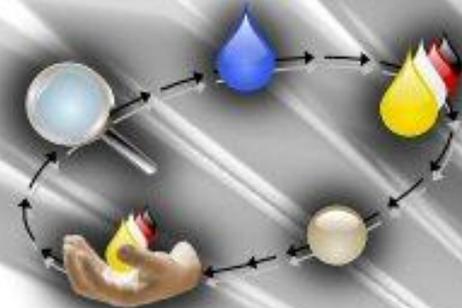




ICAO, Aerodrome Design Manual, Part 4,
Visual Aids
Appendix 3
Selection, Application and Removal of Paints

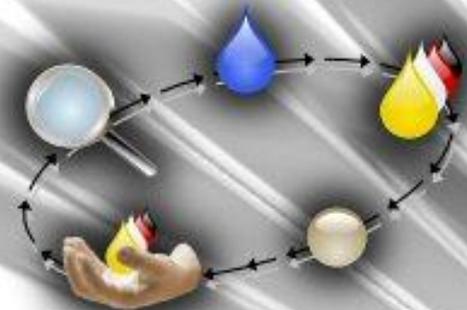
FAA: AC 150/5370-10F,
Item P-620
Runway and Taxiway Painting

Explains **HOW**
the markings are to be applied.



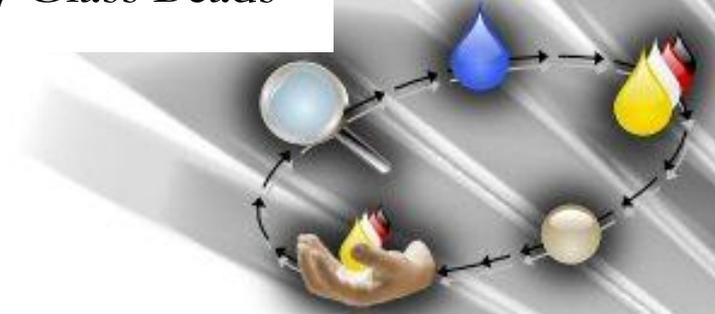
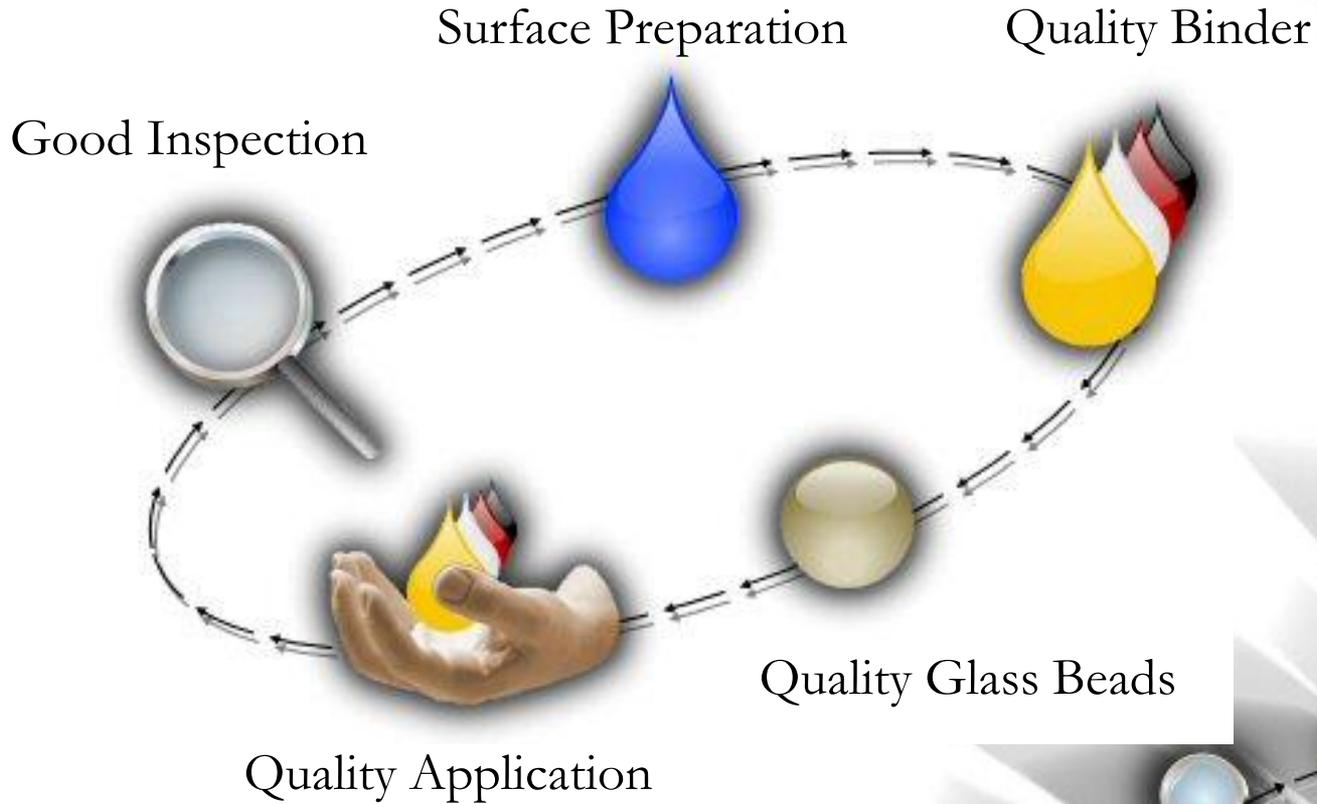
Key Elements discussed:

- Materials
- Equipment
- Application procedures
- Surface preparation
- Paint removal



Overview

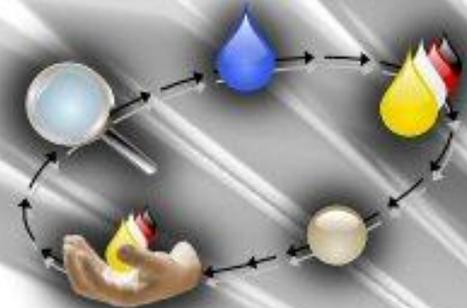
Marking System



Surface Preparation

Definition:

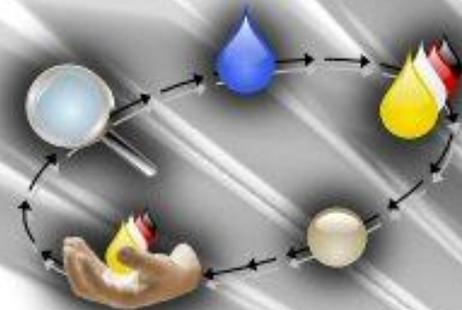
Surface preparation is the cleaning of *anything* that would prevent the bond of the new coating to either the pavement or existing coatings.



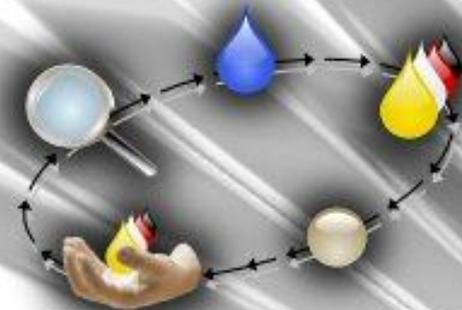
The pavement surface should be cleaned properly before initial painting and before repainting. The surface to be painted should be dry and free from dirt, grease, oil, laitance, loose rubber deposits, or other foreign material which would reduce the bond between the paint and the pavement.

(ICAO Aerodrome Design Manual, Appendix 3)

“cleaned properly” should be more specific:

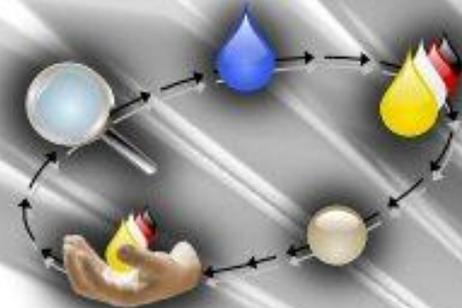


... shall be cleaned by waterblasting, shotblasting or other mechanical method to remove all loose and poorly bonded paint; and shall be followed by sweeping and blowing or by other methods as required to remove all dirt, laitance, and loose materials.



Surface Preparation

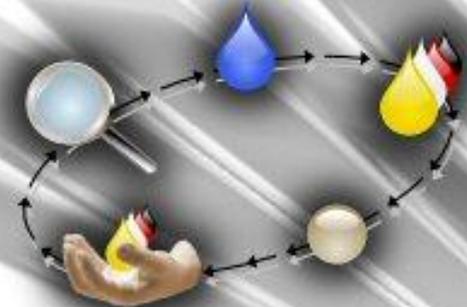
Poor Surface Preparation!



Surface Preparation

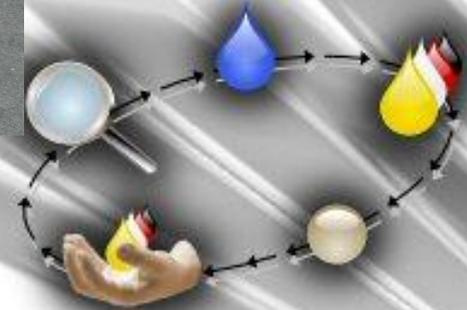
to remove contaminants:

- ✓ Dirt, rocks, and debris
- ✓ Oily substances
- ✓ Loose and flaking or poorly bonded paint
- ✓ Algae and mildew
- ✓ Curing compound on new concrete
- ✓ Rubber deposits
- ✓ Iron staining



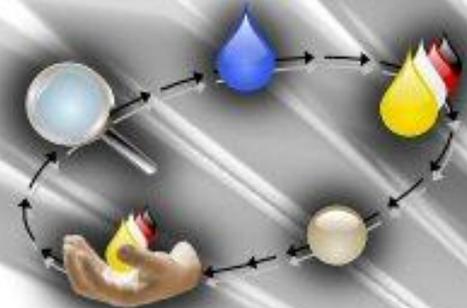
Surface Preparation

Oily Substances



Surface Preparation

Loose and Flaking Paint



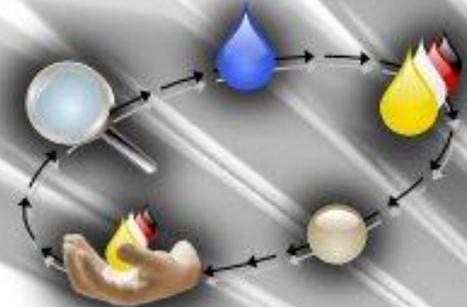
Surface Preparation

Loose and Flaking Paint



Painting over old,
peeling paint . . .

. . gives you new,
peeling paint!

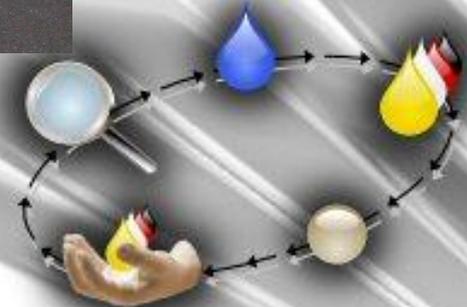


Surface Preparation

Poorly Bonded Paint



Looks like you could paint over this . . .

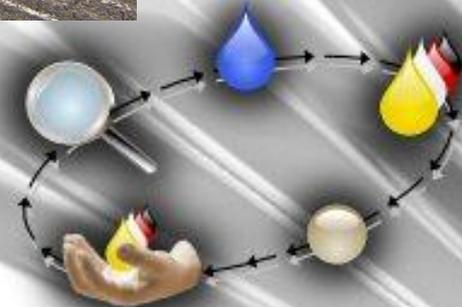


Surface Preparation

Poorly Bonded Paint is gone . . .

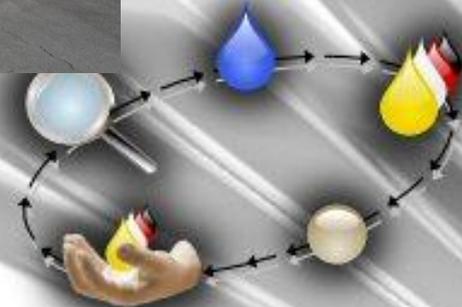


. . . by waterblasting with only 500 bar!



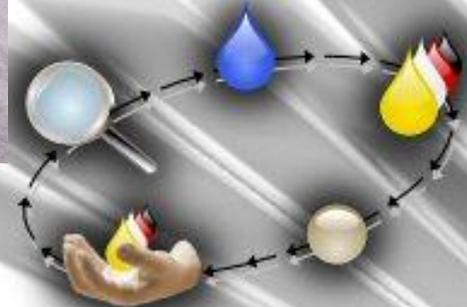
Surface Preparation

Blue-green algae



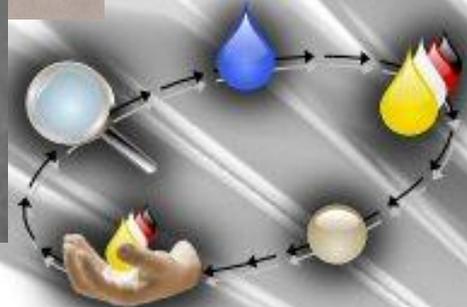
Surface Preparation

Removal of **curing compound** on new concrete is also part of surface preparation



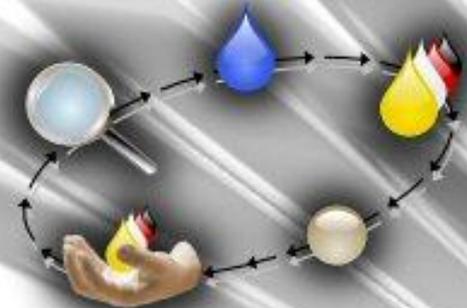
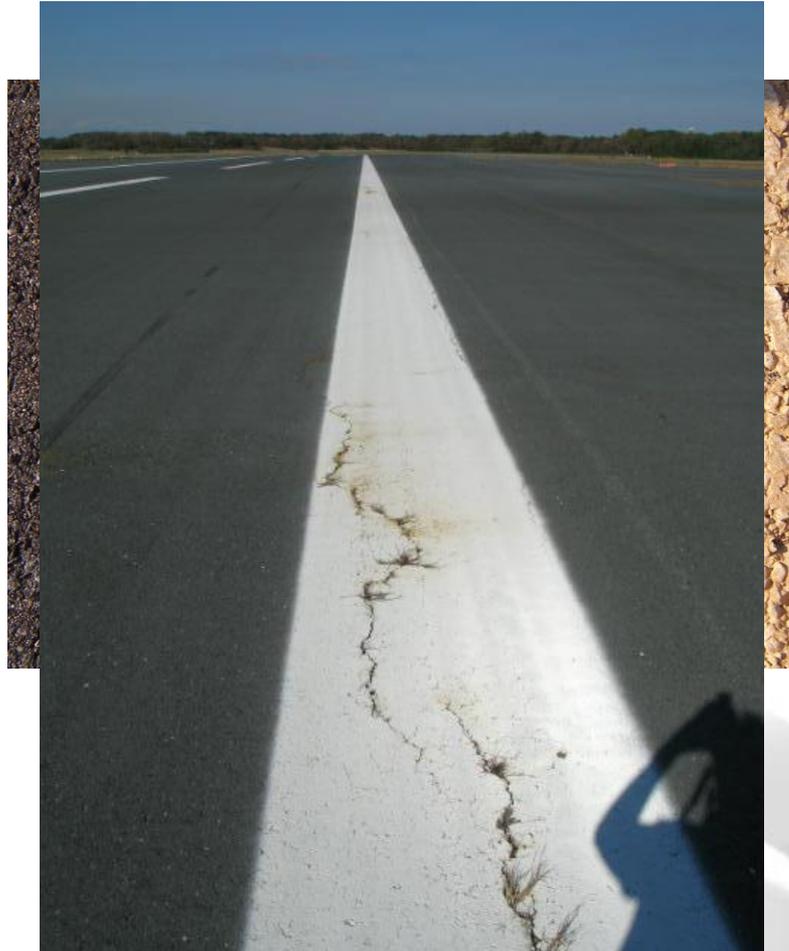
Surface Preparation

Curing compound not removed . . .
paint flakes off as curing compound sheds.



Surface Preparation

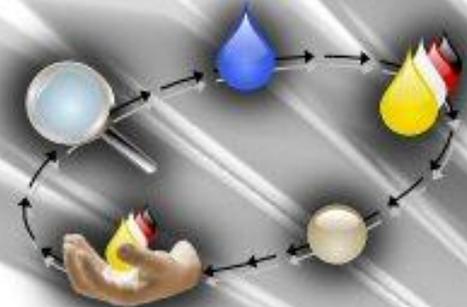
Iron Staining



Surface Preparation

Adequate surface preparation will:

- Prolong the life of the paint project
- Save valuable airport funds
- Enhance the appearance of the markings
- Prevent paint build-up
- Reduce FOD

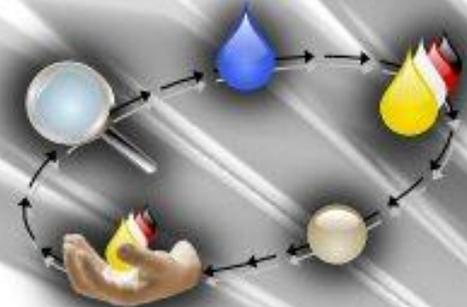


Paint Removal

ICAO, Aerodrome Design Manual, Part 4, Visual Aids
Appendix 3

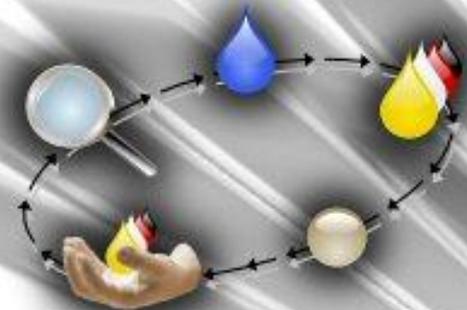
Removal of Painted Markings:

“When marking patterns are changed, physical areas or operating procedures are modified, or the thickness of the layers of paint becomes excessive, existing markings may need to be removed. Obscuration of existing markings by painting is not advised except as a temporary measure because the surface layer of paint will wear away or erode and the lower layers will become visible and may be confusing..”



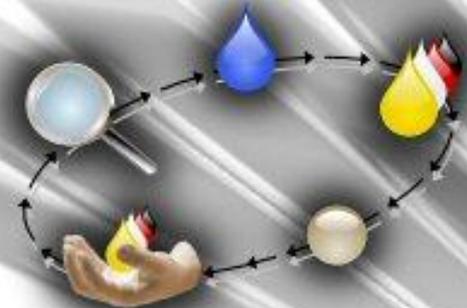
Paint Removal v. Surface Preparation

- The same equipment is used, but very differently.
- Surface preparation is the removal of loose paint, dirt, and contaminants prior to painting.
- Paint removal is some degree of eradicating the coating from the pavement.
- Paint removal is a much slower process.
- Caution must be exercised to prevent serious damage to the pavement.
- Paint removal will leave a scar.

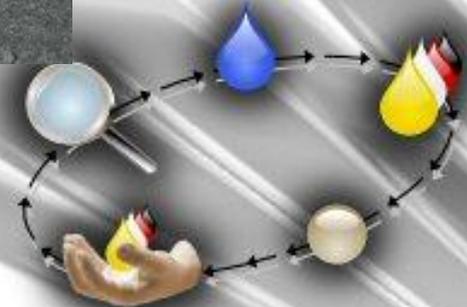


Coating Materials

- ✓ Waterborne Paint
- ✓ Solvent Paint
- ✓ Epoxy
- ✓ Methyl methacrylate
- ✓ Polyester
- ✓ Polyurea
- ✓ Thermoplastic



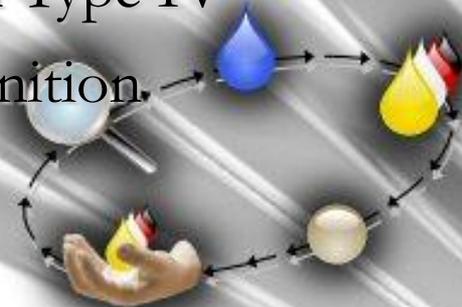
Material Modifications

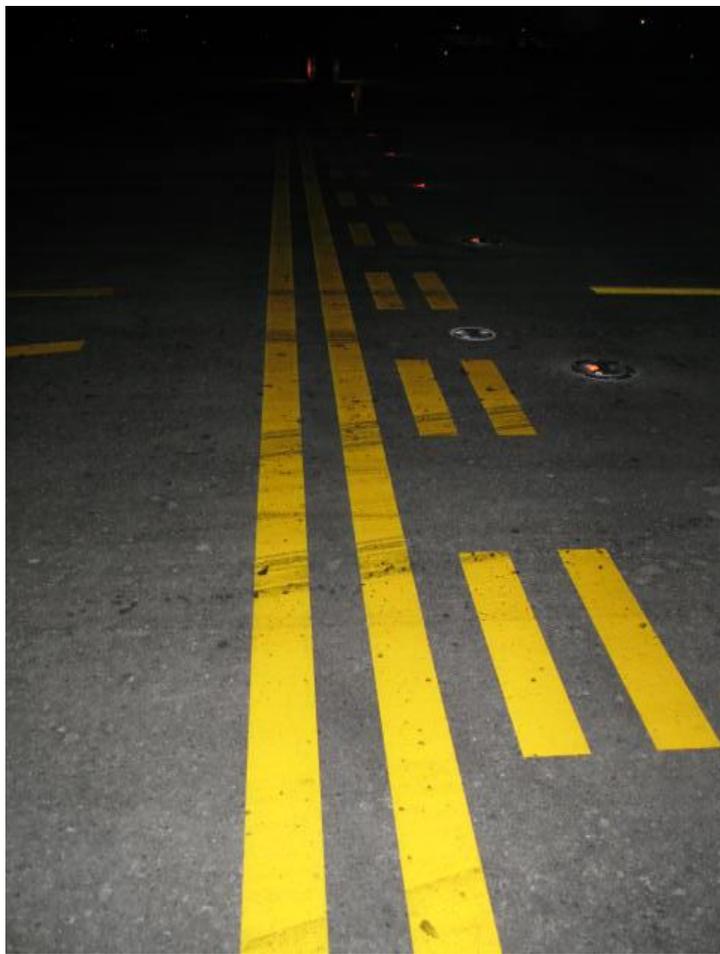


Material Selection

Glass Beads – TTB 1325D

- Low Index (1.5) composition
 - Generally made from recycled glass
 - Two sizes
 - Standard size – Type I
 - “Big Bead” (1 mm) – Type IV
- Hi-index (1.9) composition – Type III
 - Made from virgin materials
 - Larger than Type I, but smaller than Type IV
 - More reflectivity and distance recognition.

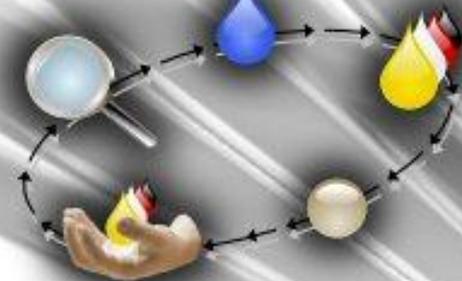




**No beads -
Visible for 20 feet.**



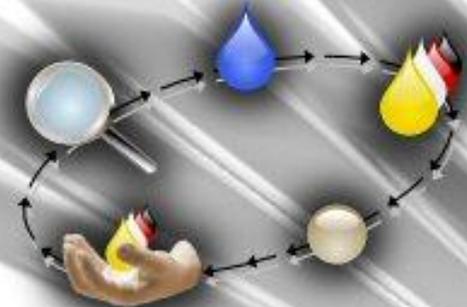
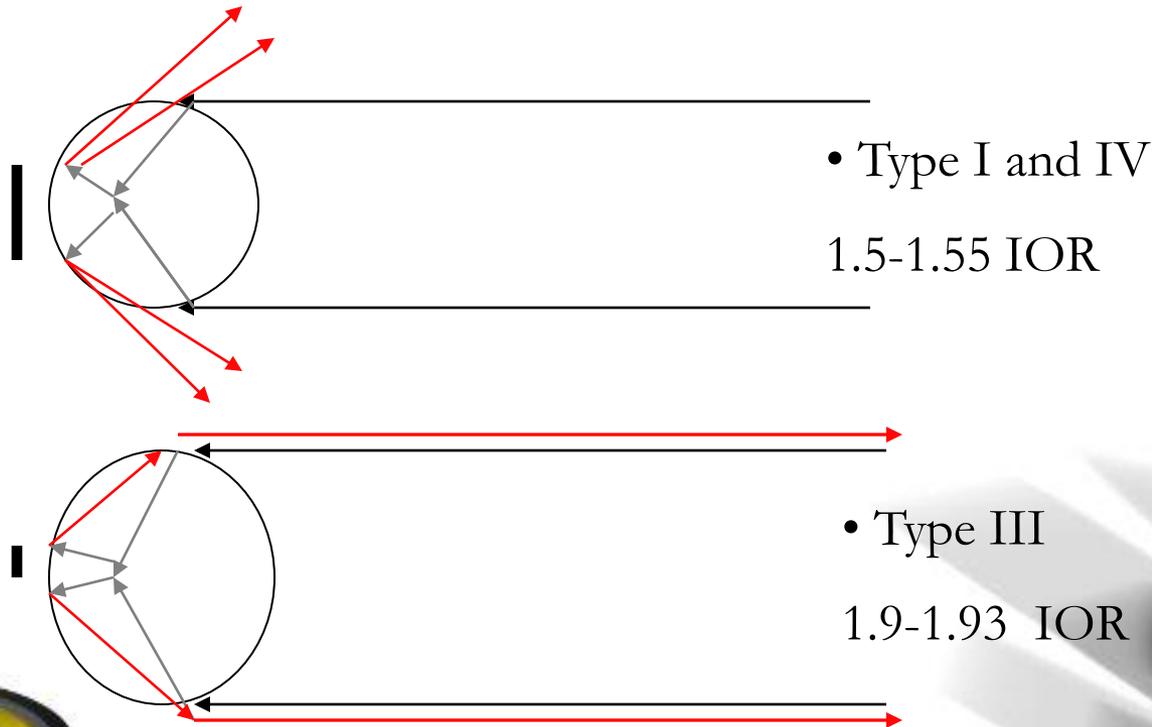
**Hi-index beads -
Visible for 100 feet.**



Glass Beads

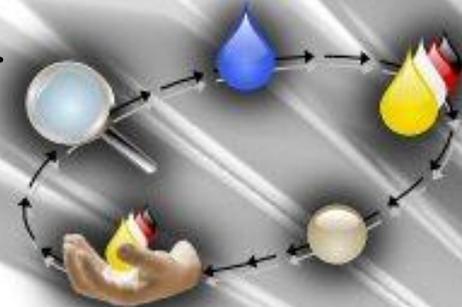
How glass beads work

Focal Point: Length of light incidence on the bottom of the glass sphere. Longer results in more diffuse reflection. Shorter results in more direct reflection.



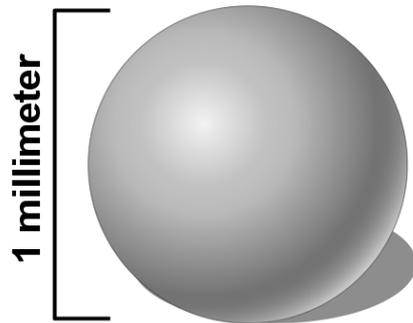
Why use glass beads?

- Increased visibility at night or low-visibility conditions.
- **Type I glass beads** offer 3-5 times more retro-reflectivity than do non-reflective markings.
- **Type IV glass beads** offer 2-3 times more retro-reflectivity than do **Type I beads**.
- **Type III** glass beads offer 3-5 times more retro-reflectivity than do **Type I beads**.
- Higher retroreflectivity readings mean better visibility from a greater distance.
- Reduction of runway incursions due to greater visibility.

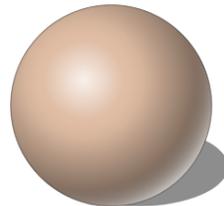


Factors that affect Retro-Reflectivity

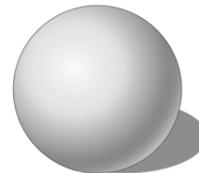
Glass Bead Sizes



Type IV Bead*
"Big Bead"
Reclaimed Glass
or Direct Melt
1.5 IOR



Type III Bead**
"Airport Bead"
Virgin Glass
1.9 IOR

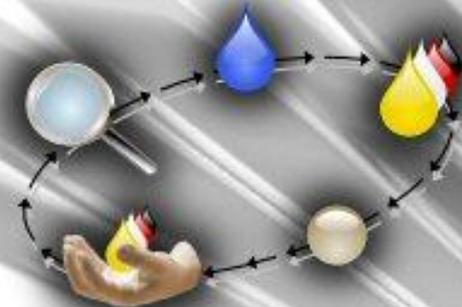


Type I Bead***
"Highway Bead"
Reclaimed Glass
1.5 IOR

*At *installation*, Type IV should yield 350-500 mcd/m²/lux on white markings and 200-350 mcd/m²/lux on yellow.

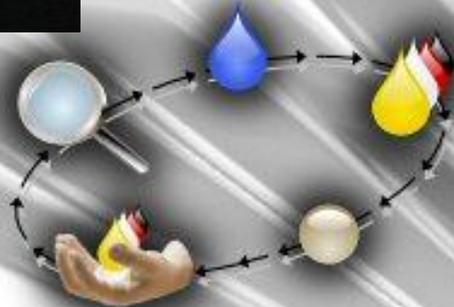
**At *installation*, Type III should yield 600-1300 mcd/m²/lux on white markings and 350-550 mcd/m²/lux on yellow.

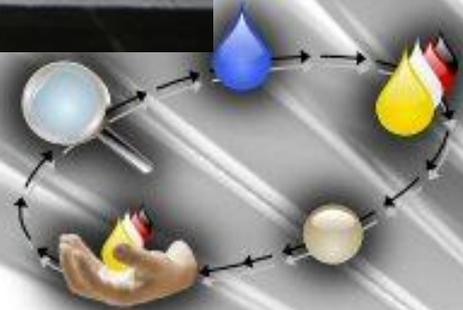
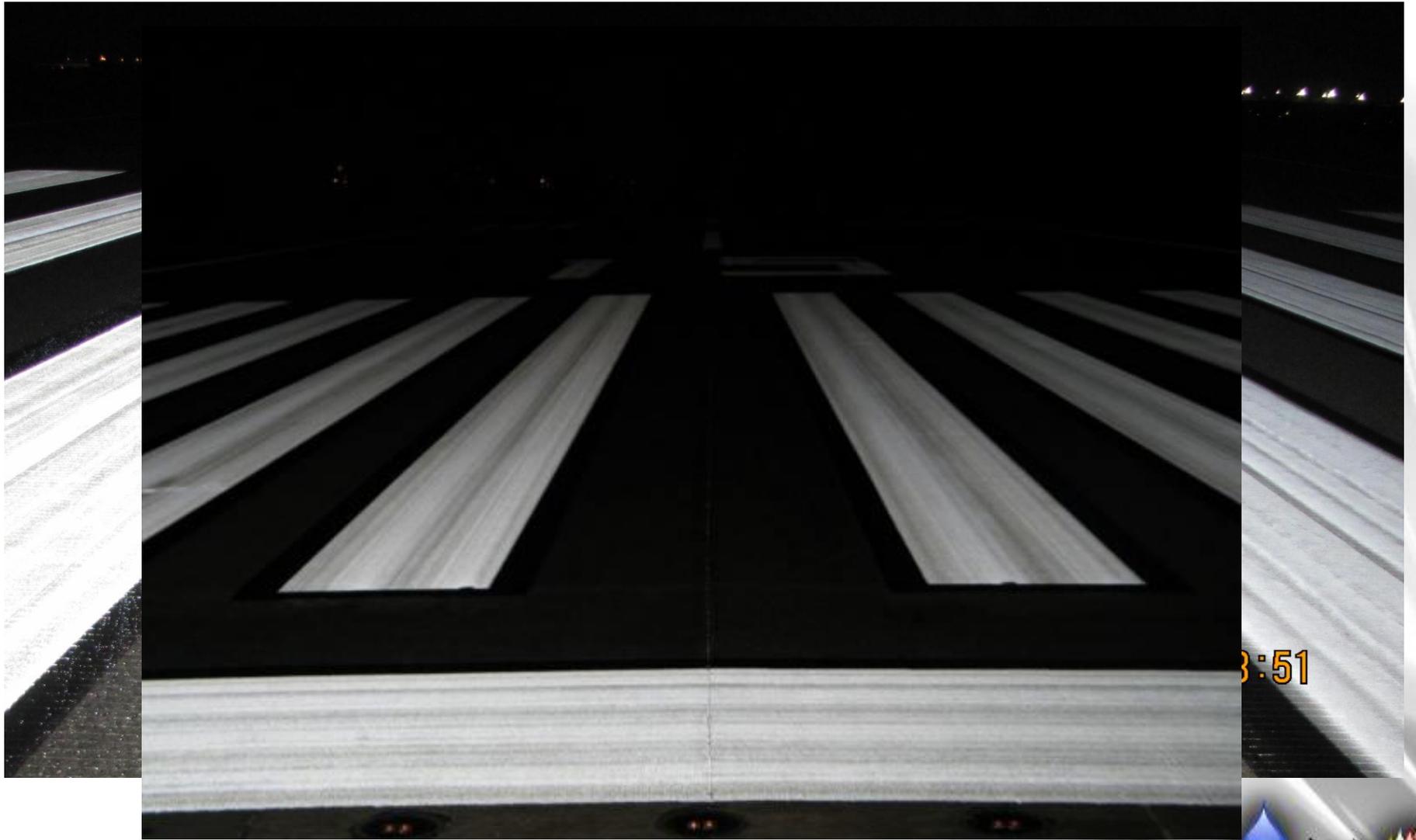
***At *installation*, Type I should yield 300-450 mcd/m²/lux on white markings and 175-250 mcd/m²/lux on yellow.



Tails with Type I recede from view in the distance

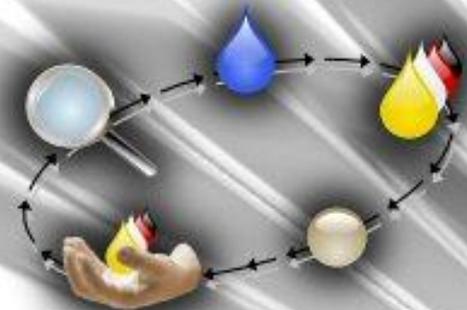
Arrowheads with Type III beads are highly visible from 200 feet.





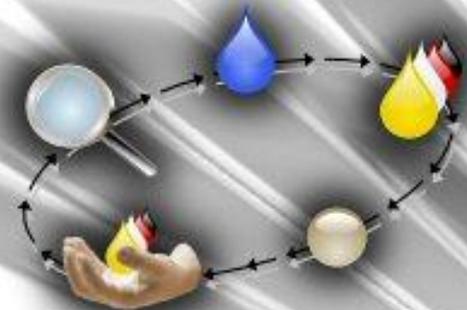
Markings: the Challenge

- ➔ Coatings deteriorate gradually.
- ➔ When to maintain is subjective.
- ➔ The ICAO/FAA inspector can't see everything.
- ➔ It's the airport's responsibility to know if the markings are effective.
- ➔ Marking deficiencies decrease situational awareness, compromising safety.
- ➔ Poorly applied markings perform poorly immediately.

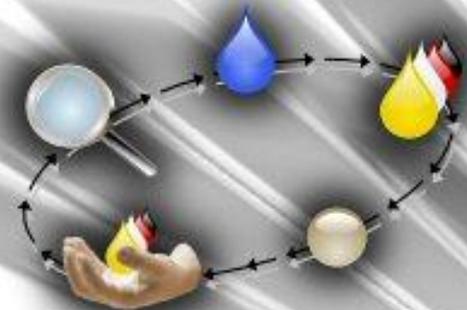


Markings can last longer:

- ✓ IF they are not thick or peeling.
- ✓ IF the surface is properly prepared.
- ✓ IF they are applied using quality materials.
- ✓ IF they are applied using best practices.
- ✓ IF they are properly inspected.

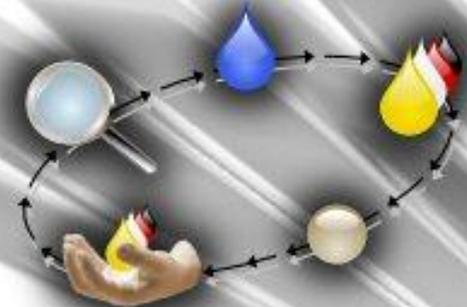


How can you determine
if your markings are
effective?



Airfield Marking Assessment

- ✈ Marking Condition Index (MCI©)
- ✈ Airfield markings are assessed for the following characteristics:
 - ✓ Visibility
 - ✓ Durability
 - ✓ Compliance



Airfield Marking Audit

✓ Visibility

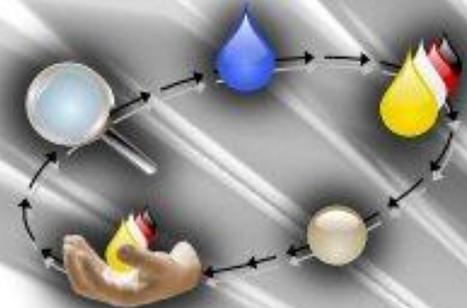
- Retro-reflectivity.
- Color.

✓ Durability

- Adhesion.
- Thickness/number of layers.
- Condition of pavement under markings.

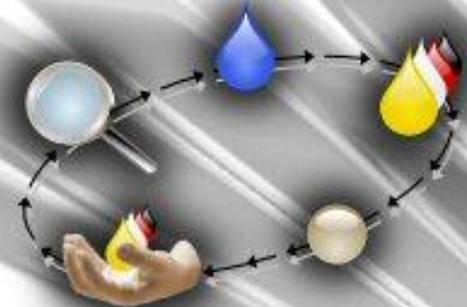
✓ Compliance

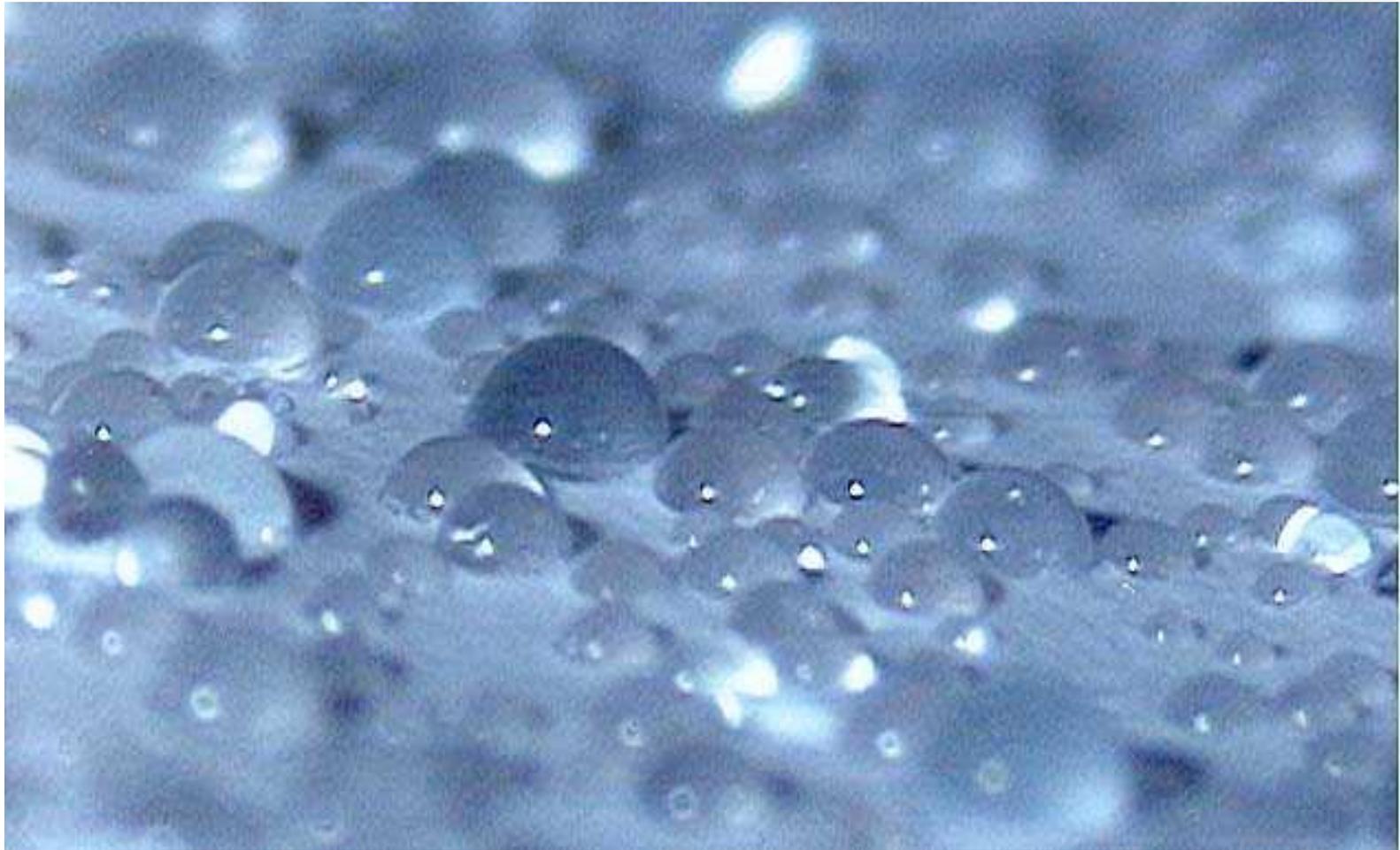
- Alignment
- Dimension
- Placement



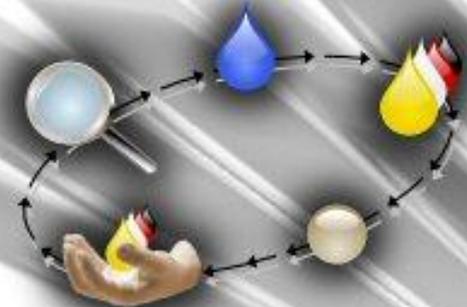
VISIBILITY

- ➔ Retro-reflectivity – brightness of the marking during darkness.
- ✓ Embedment – Optimal is 50% of bead in coating.
- ✓ Population – More beads visible than paint.
- ✓ Distribution – Even beads across entire marking.

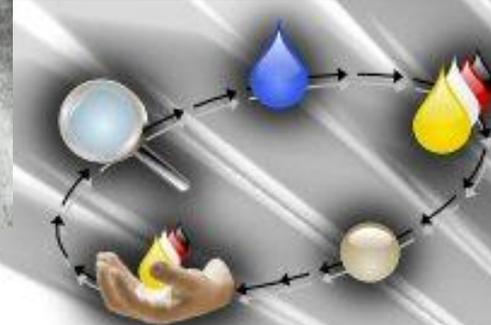
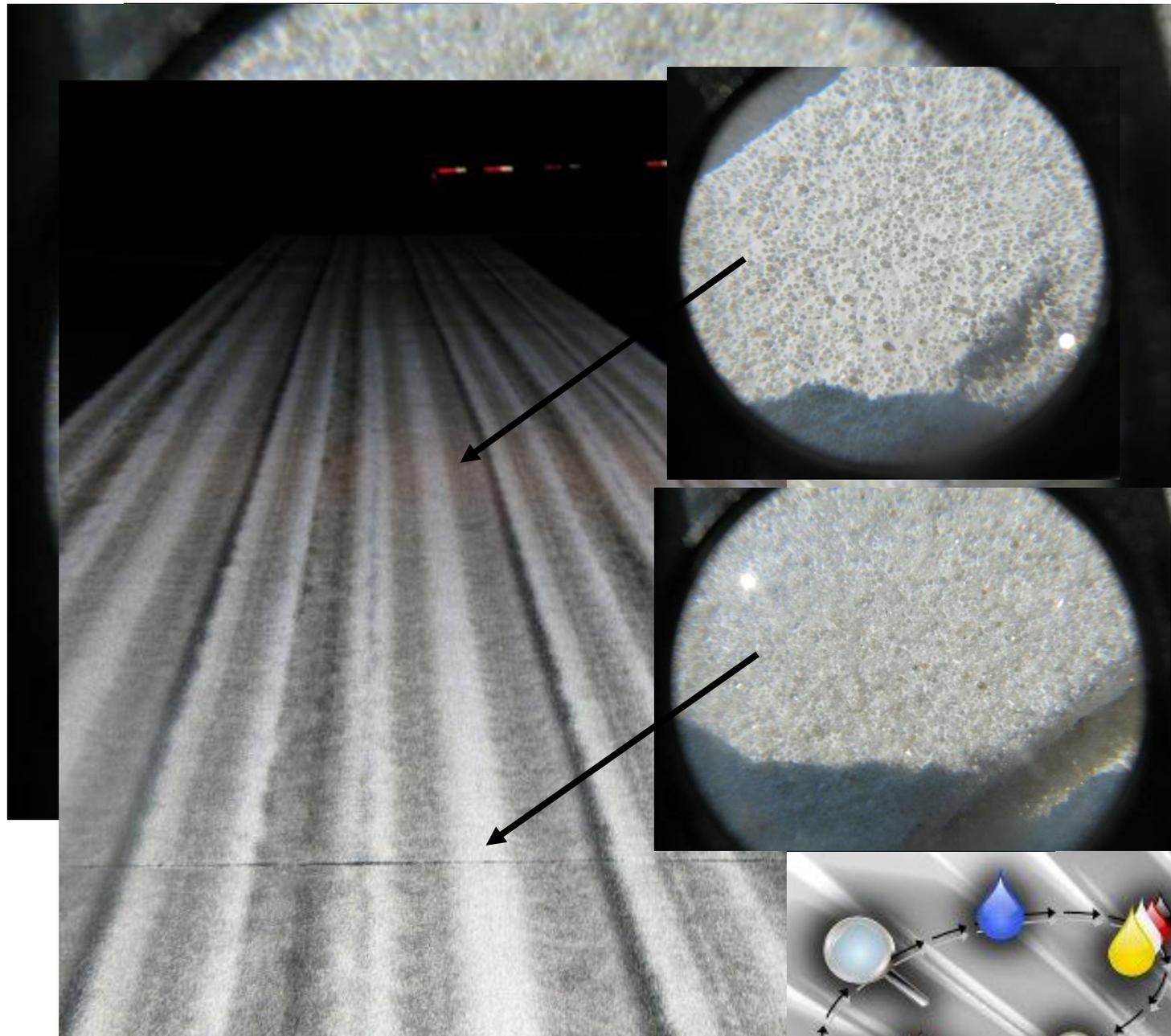




Embedment

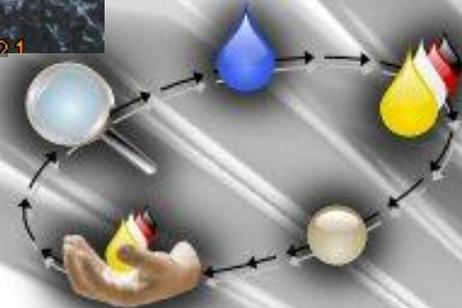
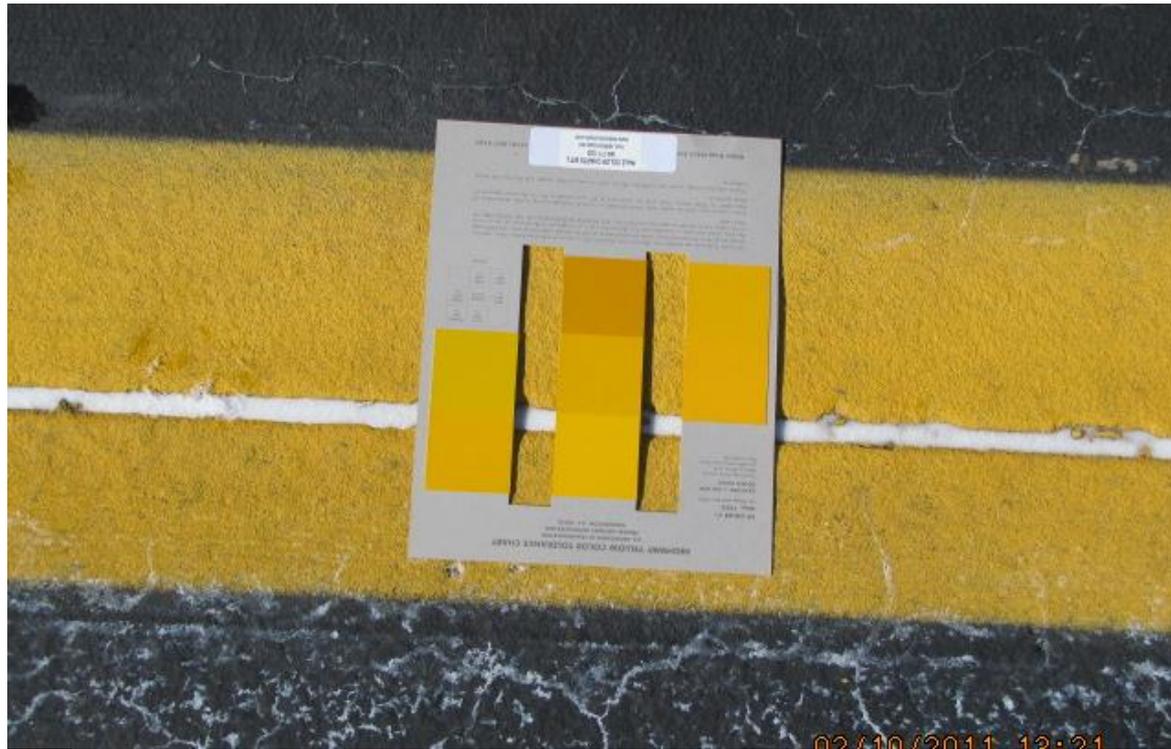


Population And Distribution



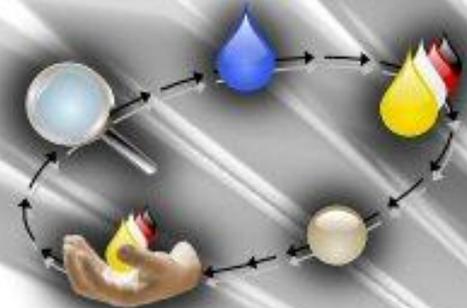
VISIBILITY

➔ Color – based on Federal Color Codes.

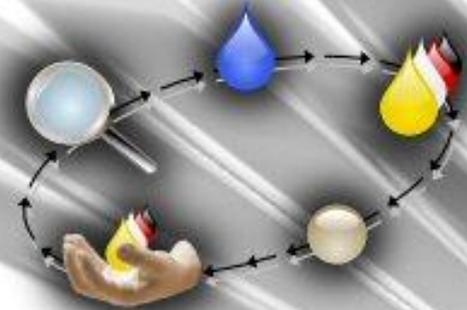


DURABILITY

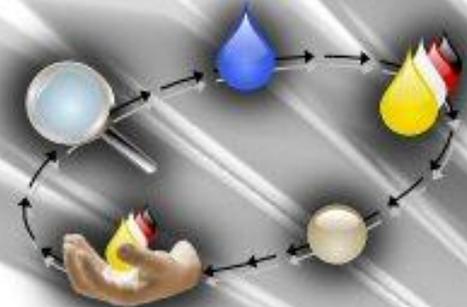
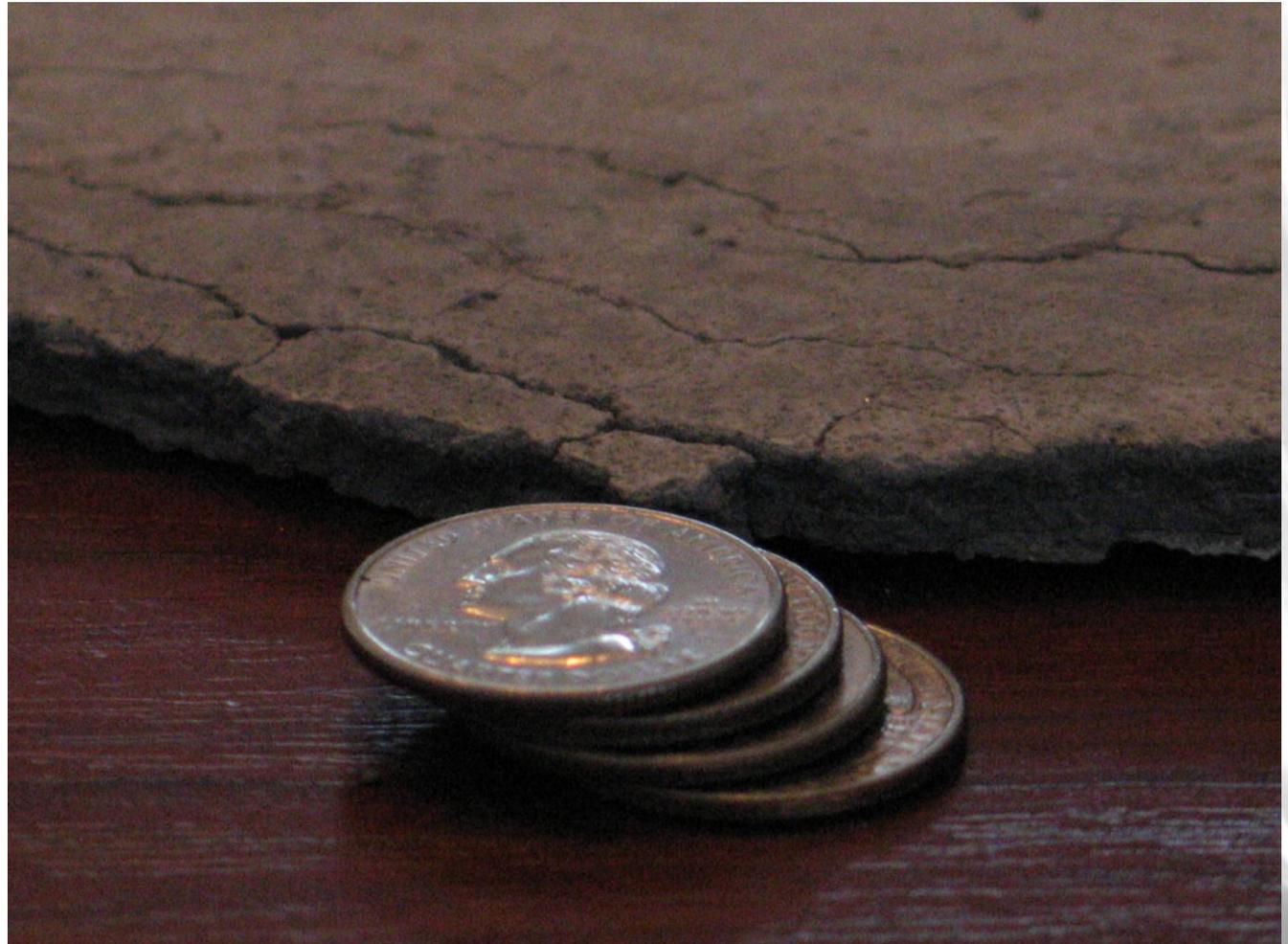
- ✓ Adhesion quality.
- ✓ Thickness of coatings.
- ✓ Condition of pavement under the markings.



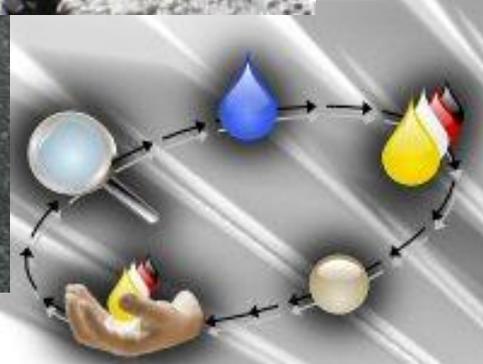
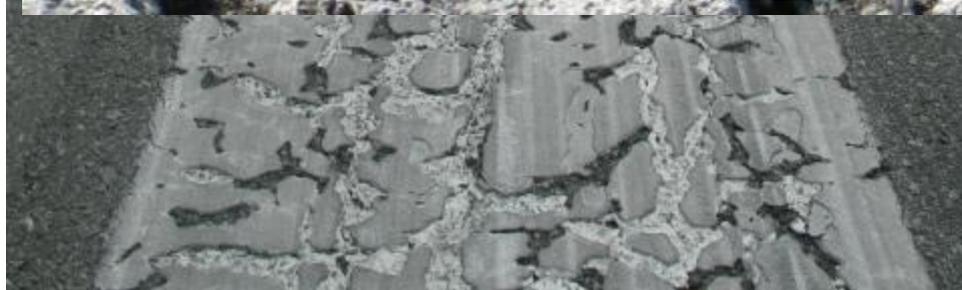
Adhesion



Coating Thickness

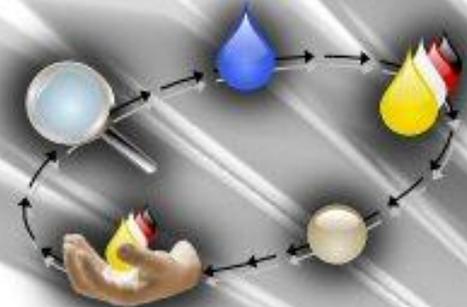


Pavement Condition Below Markings

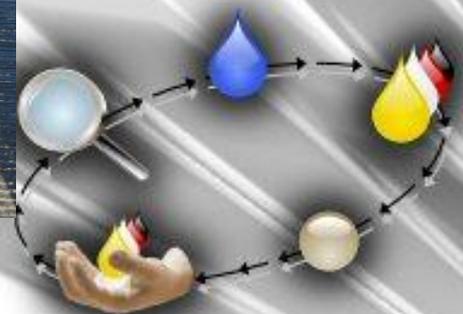
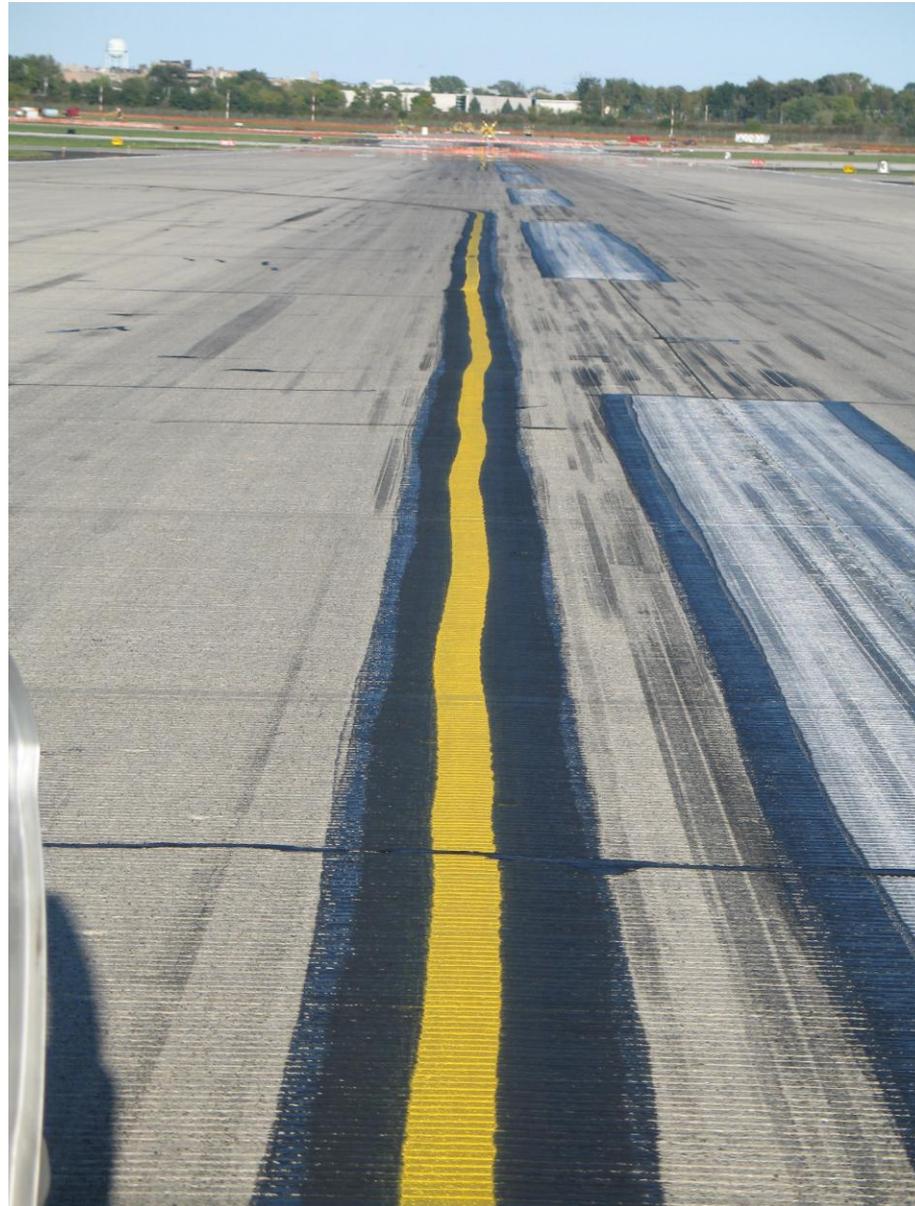


COMPLIANCE

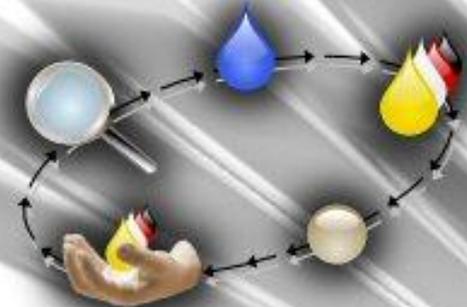
- ✓ Alignment
- ✓ Dimension.
- ✓ Placement.



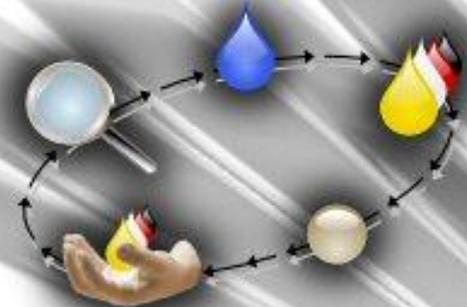
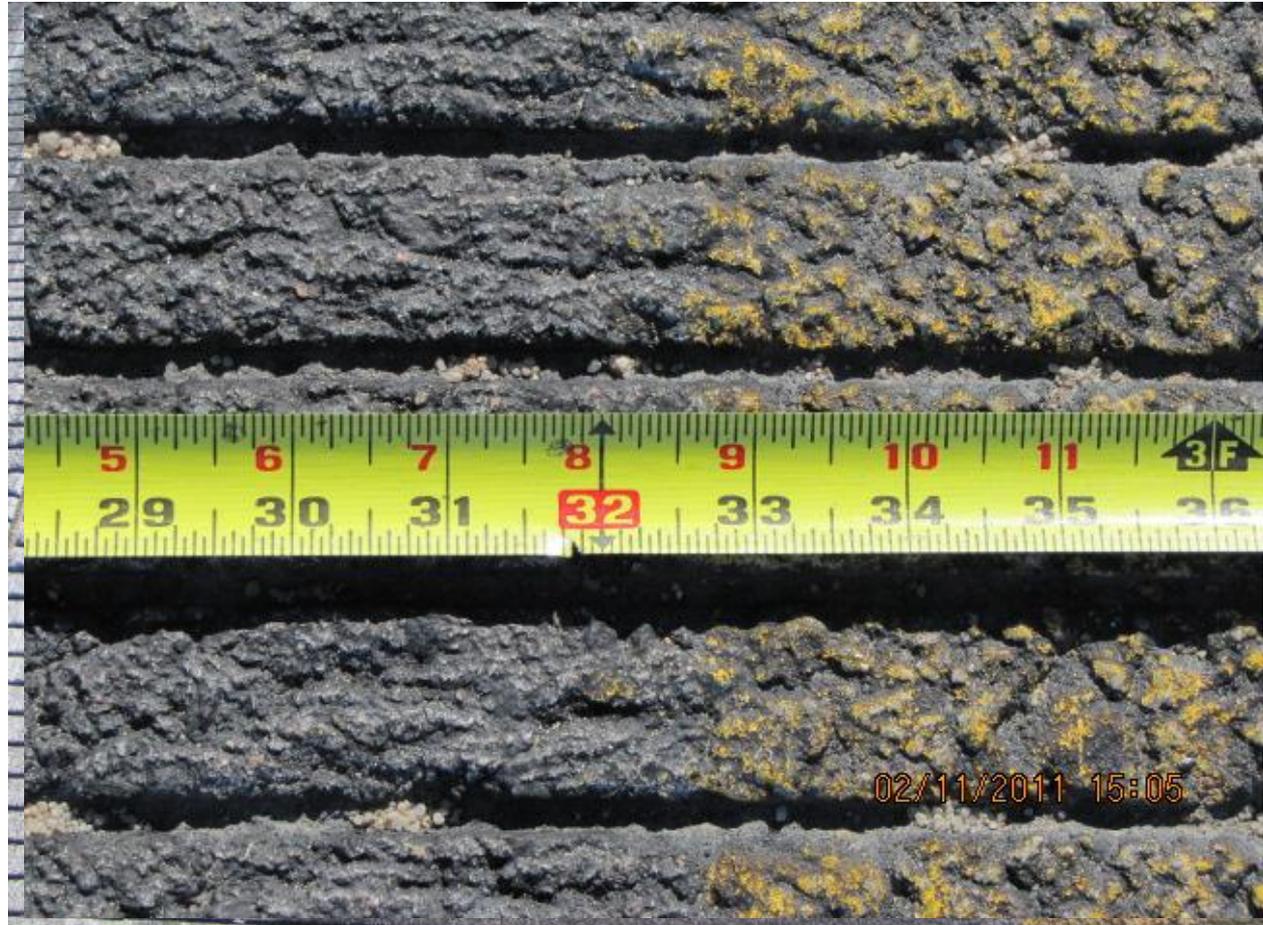
Alignment



Dimension

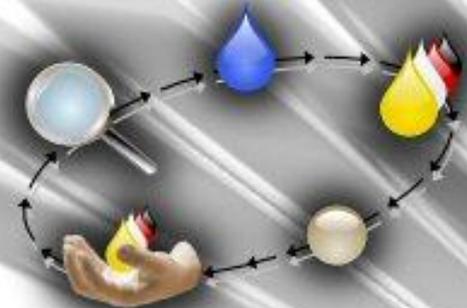


Placement



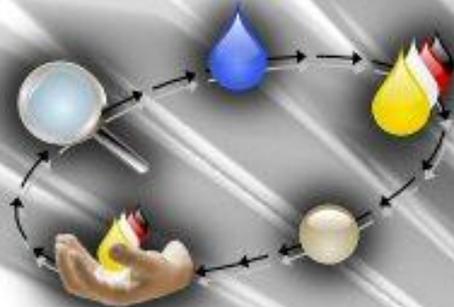
Summary

- ➔ Markings are important for safe navigation.
- ➔ Having *effective* markings is imperative.
- ➔ Recognize and fix what is broken.
- ➔ Install markings using best practices.
- ➔ Inspect, inspect, inspect.



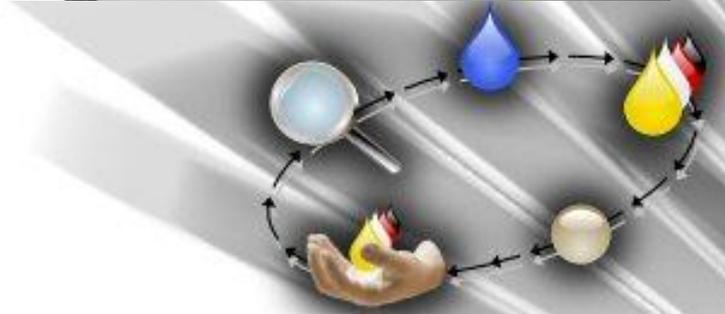


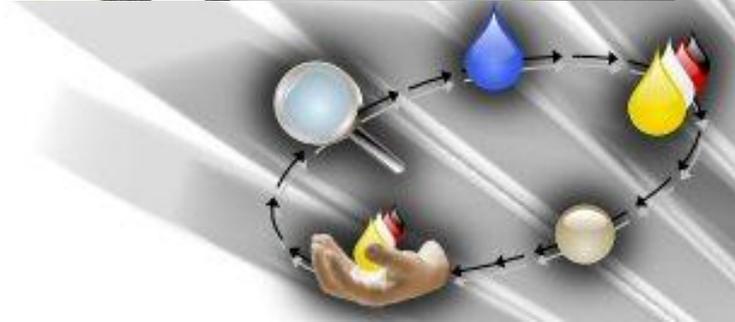
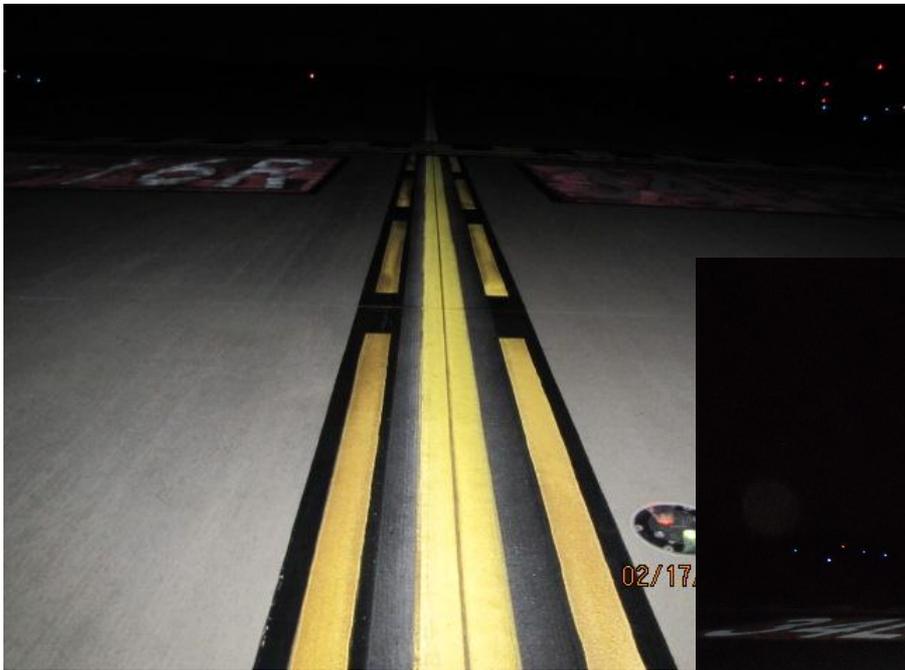
Before
Training





After
Training

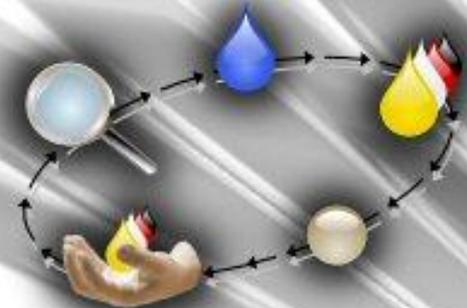




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Airfield Marking Symposiums

- San Antonio, Texas, May 14-15, 2012
- Newark, NJ, July 9-12, 2012
- Denver, Colorado, September 17-19, 2012
- Daytona Beach, Florida, November 12-14, 2012





Thank you.