

CHAPTER 3 TRAFFIC PAINT

OBJECTIVES

- 1) Traffic Paint
- 2) Components
- 3) Reflective Beads
- 4) Characteristics of Waterborne Paint
- 5) Characteristics of Solvent Borne Paint
- 6) Application Considerations

TRAFFIC PAINT

Traffic paint is a thin layer of blended material. This chapter will describe waterborne traffic paint and solvent borne traffic paint. Reflective beads are added to the surface of the paint during application to produce nighttime retroreflectivity.

COMPONENTS

Paint is mainly composed of finely ground pigments that are mixed into a resin or binder system. Then various ingredients and additives are incorporated for certain desired properties. A liquid (water or solvent) is added to the mixture to produce a material that is pliable by application equipment. All of the ingredients/components in traffic paint are added specifically for one or more of the following functions: aiding the manufacturing process, increasing storage time in containers, easing application, and increasing durability once the paint has been applied.

Prime Pigments

Prime pigments are used to impart chemical properties such as UV stability, or physical properties such as color and hiding. Hiding is the ability of a paint to cover or block out the surface (substrate) beneath it. Titanium dioxide is typically used to make a white color. It is the primary pigment that gives traffic paint good hiding power.

Lead chromate was typically used to make a yellow color. However, due to health concerns with lead chromate pigments, organic pigments are now being used as a substitute for the lead chromate. Some types of pigments can be used interchangeably between solvent borne and waterborne traffic paint.

Extender Pigments

Once the necessary amount of prime pigment is added for hiding, less expensive extender pigments or fillers are used to bring the pigment level up to the required point. Extender pigments not only reduce cost, they give paint consistency, durability, permeability, and scrubability. These properties are very important when considering the harsh environment and abuses that traffic paint must withstand. The main types of extenders are aluminum silicate (china clay), calcium carbonate, calcium sulfate, and magnesium silicate.

Resins or Binders

The resin is the component that bonds the pigment and beads together. It also provides the adhesion to the road surface. The resin is the binder or glue in paint.

Waterborne paints typically use three types of resins. They are polyvinyl acetate latex, methylmethacrylate, or a one-hundred-percent acrylic resin. These materials are pre-reacted and put into solution using emulsifiers. These emulsions are materials that normally do not mix. Once the paint has been applied, it must allow the water to evaporate in order for the paint to “break” and adhere to the roadway. This settling is generally called coalescence. One-hundred-percent acrylics are used predominantly due to faster “no track” times and less heat needed during application.

Because of high humidity, waterborne paint will take longer to dry. Therefore, on low humidity days, waterborne paint will dry much faster. When there is less water in the air, the water can leave the film or evaporate much faster.

Solvent borne paints are typically linseed or soya oils and alkyd resins. These paints cure by solvent evaporation and the resin reacts with atmospheric oxygen to create a solid bond to the pigments, beads, and road surface. Some types of solvents used in these paints are naphtha, toluene, methanol, methylene chloride, and acetone. They are added to thin the paint out and make it easier to handle and spray.

Both waterborne and solvent borne paint resins have a critical value for the quantity of material that the resin can hold. This is called the critical-pvc pigment volume concentration. If this concentration is exceeded, the resin will not be able to bind the pigment and beads. This could also affect adhesion to the road surface.

Solvents

With waterborne paint, the water is more of a diluent rather than a solvent. It holds the resin emulsion in solution with the other components until the paint has been applied. Fast-dry waterborne paints may contain ammonia and/or methanol. Ammonia and methanol are Volatile Organic Compounds (VOCs). These VOCs accelerate the curing process throughout evaporation.

In solvent borne paints, the evaporation rate is very important. Because of this, they need to be tailored to leave the film at the right time. When solvents evaporate too fast, the surface can skim over and trap the rest of the solvents within the film. Most solvent blends keep the film open while solvents escape. That is why, as a general rule, just any solvent will not work.

Heat can be considered as a solvent for both waterborne and solvent borne traffic paint because it can be used to make paint more fluid and aid in evaporation.

Volatile Organic Compounds evaporate in the air. The Environmental Protection Agency (EPA) was mandated to establish VOC emission controls for “all field applied coatings.” The Clean Air Act Amendment (CAAA) of 1990 designated these controls as “architectural coatings.”

This category is very broad ranging from interior house paints to heavy-duty industrial maintenance coatings. Different VOC limits were established according to the intended use of the coatings. Traffic Marking Coating VOC limits were set at 1.25 lbs/gal. This is the result of the EPA's effort to reduce ozone, which is a significant ground level health hazard. A few materials, acetone and some special chlorinated solvents, have been declared exempt from these regulations because they don't increase ozone levels. From a 1990 nationwide baseline, the annual reduction of VOC emissions is 10,600 tons.

Additives

Additives are included in paint to help prevent problems. One example is an anti-foam agent, which keeps paint from foaming during the high-speed mixing process. Other additives help prevent the paint from freezing, settling, or skimming in the drum. Additives usually only make up 0.1 to 5 percent of the paint. Some have a single function and others may have multiple functions. For example, ammonia acts as an accelerator for drying and keeps the pH level up in waterborne paint while being stored. It is important to maintain the pH level at 9.5 or higher to ensure the latex remains suspended in solution.

REFLECTIVE BEADS

A separate gun adds reflective beads to the wet paint at the time of application. Some agencies may also require the premixing of beads into the paint prior to application.

Reflective beads for painted markings are typically applied under pressure. This is necessary for the beads to achieve the proper embedment in the paint before its fast drying nature causes it to form a surface skin. The bead supply tank is pressurized to force the beads through the system to the bead gun. Since the system is under pressure and is not loaded in a vacuum, moisture can condense inside the tank and cause clogging problems. For this reason, the manufacturer usually adds a moisture-proofing agent. Beads are typically applied at a minimum rate of 6 pounds of beads per gallon of paint.

Beads are generally shipped in 50-pound bags with 40 bags shrink-wrapped on a pallet. They may also be shipped in 2,000-pound boxes.

CHARACTERISTICS OF WATERBORNE PAINT

There are many disadvantages and advantages to using waterborne paints for pavement markings. One major disadvantage of waterborne paint is its sensitivity to temperature. Precautions must be taken to protect stored material from freezing and extreme heat. During application, latex paint is very sensitive to high humidity, which can drastically increase drying time. Conversely, low humidity creates a quicker drying time. Paint is also the least durable of all the markings and is not recommended for roadways with high traffic volumes.

Some advantages of waterborne paint are cost. It is the least expensive of all pavement markings. It can be applied at a faster rate than most other markings and under ideal conditions it can have a very fast dry time. Also, no solvents are needed for clean up. Fast dry waterborne paint will achieve its best drying times under perfect ambient conditions: daytime, sunny, 70°F, low humidity and a breeze.

Some characteristics of waterborne paint are:

- Heat sensitivity
- Freezes easily
- Strong ammonia odor
- Humidity may affect drying times
- Can be flushed out with water and/or ammonia
- Generally not a hazardous waste for disposal - placarding not required (dependant on formulation)
- Reacts adversely to metals other than stainless steel
- Requires specially lined drums to prevent chemical reaction
- Can settle in the drum

CHARACTERISTICS OF SOLVENT BORNE PAINT

Some characteristics of solvent borne paint are:

- Humidity generally not an application problem
- Heat exchanger can be heated higher to assist in drying times
- Can film form at lower temperatures than waterborne
- Solvent blend critical to prevent skimming
- Requires placarding of vehicle
- Clean up flush material is hazardous waste
- Unused paint is hazardous waste for disposal purposes
- Can be very flammable
- Can easily settle in drum

Traffic paint is a one-component material that is generally shipped in 55-gallon drums with full open top lids. Traffic paint generally has a shelf life of one year. This information should appear on the shipping documents. Quality assurance tests may be performed to confirm that the original formulation is approved by the government agency and to verify the manufacturer's certification.

No paint forms a film well when applied at low temperatures.

APPLICATION CONSIDERATIONS

Traffic paint is applied by conventional or airless spraying.

Conventional

Conventional spraying uses air jets in the tip of the paint gun to break up, or atomize the paint. The tip then defines the shape of the spray to produce a properly applied line. The quantity of atomizing air needed to sufficiently break up the paint will depend to a large extent on the paint's rheology, or flow characteristics.

The pressure needed to force the paint through the application system and out of the gun can vary from 60 to 140 psi, depending on the size of the plumbing and the type of spray gun used. This can be achieved using one of the following methods:

- In a pressure-pot system, the holding tank is pressurized to push the paint through the heat exchangers and lines to the gun for application.
- In a pumper system, the holding tank is not pressurized. A diaphragm pump is used to draw the paint from the tank and force it through the system and out to the gun.

Airless

In an airless system, the paint is forced out through an orifice in the tip of the gun at a high pressure. The size of the hole determines how much paint is applied and the angle of the inner surfaces of the tip determines the width. Unlike the conventional system, there is no air mixed with the paint in the gun. The pressure created by the pump mechanism explosively forces the paint through the gun tip breaking the paint up into very small particles. The primary method for altering the width and thickness of the applied line is to change the tip. Chapter 11 shows a picture of a long liner truck.

Additional factors must also be considered when applying traffic paint:

Material Temperature

The manufacturer's Product Data Sheets specifies the material application temperature ranges. Fast-dry (ammoniated), waterborne paint only needs enough heat to allow a good flow of material through the application system (generally in the range of 90 °F to 120 °F at the gun tip).

It is very important not to overheat the solvent or waterborne traffic paint because they can ignite. Overheating fast dry, waterborne paint can also “drive off” the methanol and ammonia creating longer dry times. These two additives act as driers to keep the paint film open, helping the water escape.

Ambient Conditions

Waterborne paint requires liquids to evaporate. This evaporation is dependent on the humidity (moisture in the air). Humid days will cause drying problems. Lower humidity and good air movement greatly improves waterborne materials drying. To achieve the optimal results, neither solvent nor waterborne traffic paint shall be applied below 50 °F (air temperature).

Pavement Surface Considerations

The pavement shall be free of dirt, oil, grease, laitance, curing compounds, and moisture. On new HMA pavements, paint may dissolve road oils and cause a discoloration of the line. This line should be repainted as soon as it has dried in order to achieve the proper color.

Quality Assurance Field Testing

Quality assurance field-testing shall be conducted in accordance with agency specifications. Figure 3.1 is a troubleshooting guide for paint application problems.

Figure 3.1 - PAINT APPLICATION TROUBLESHOOTING GUIDE

PROBLEM	CAUSE	EFFECT	REMEDY
Excessive Thickness (overall)	<ul style="list-style-type: none"> • Paint tank pressure too high • Paint gun volume control (if present) open too wide • Pump pressure too high • Applicator speed too low 	<ul style="list-style-type: none"> • Buried beads – poor initial nighttime retroreflectivity • Slow drying time – paint tracked by motorists • Paint won't cure properly – shortened life 	<ul style="list-style-type: none"> • Reduce tank pressure • Adjust paint gun volume control • Reduce pump pressure • Increase speed
Excessive Thickness (middle of line)	<ul style="list-style-type: none"> • Paint tank pressure too high • Paint gun volume control (if present) open too wide • Pump pressure too high • Atomizing air pressure off or too low • Material buildup in paint gun tip and/or shroud 	<ul style="list-style-type: none"> • Buried beads – poor initial nighttime retroreflectivity • Slow drying time – paint tracked by motorists • Paint won't cure properly – shortened life 	<ul style="list-style-type: none"> • Reduce tank pressure • Adjust paint gun volume control • Reduce pump pressure • Increase atomizing air pressure • Clean tip and/or shroud
Excessive Thickness (along one side)	<ul style="list-style-type: none"> • Material buildup in paint gun tip and/or shroud • Clogged hole(s) in paint gun atomizing tip 	<ul style="list-style-type: none"> • Buried beads – poor initial nighttime retroreflectivity • Slow drying time – paint tracked by motorists 	<ul style="list-style-type: none"> • Clean paint tip and/or shroud • Clear clogged hole(s) in paint gun atomizing tip
Insufficient Thickness	<ul style="list-style-type: none"> • Paint tank pressure too low • Paint gun volume control (if present) not open enough • Pump pressure too low • Applicator speed too low • Atomizing pressure too high • Material buildup in paint gun tip and/or shroud • Material buildup in paint filter(s) and/or plumbing 	<ul style="list-style-type: none"> • Poor line quality and/or shortened life • Beads won't adhere and/or poor or no nighttime retroreflectivity 	<ul style="list-style-type: none"> • Increase tank pressure • Adjust paint gun volume control • Increase pump pressure • Decrease speed • Decrease atomizing air pressure • Clean paint gun tip and/or shroud • Clean paint filter(s) and/or plumbing
Paint Line not drying	<ul style="list-style-type: none"> • Surface temperature too cold • Material over heated • High humidity • Material past shelf life 	<ul style="list-style-type: none"> • Vehicle tracking markings • Tracked marking no longer has required retroreflectivity 	<ul style="list-style-type: none"> • Cone Markings • Reduce material temperature • Stop applying markings until environment improves • Check surface temp. • Check age of material

PAINT APPLICATION TROUBLESHOOTING GUIDE- Continued			
PROBLEM	CAUSE	EFFECT	REMEDY
Wide Paint Line	<ul style="list-style-type: none"> • Paint gun set too high • Worn or damaged paint gun • Tip and/or shroud 	<ul style="list-style-type: none"> • Line does not meet standards • Line has fuzzy edges 	<ul style="list-style-type: none"> • Lower gun • Repair or replace tip and/or shroud
Narrow Paint Line	<ul style="list-style-type: none"> • Paint gun too low • Paint gun tip slot not at 90° angle to paint line • Clogged paint gun tip and /or shroud • Low air pressure in paint machine tire. 	<ul style="list-style-type: none"> • Line does not meet standards • Not as visible as a full – width line (day or night) 	<ul style="list-style-type: none"> • Raise paint gun • Reposition paint gun tip • Clean paint gun tip and/or shroud • Inflate tire
Uneven Paint Line (spotty)	<ul style="list-style-type: none"> • Atomizing air pressure too low • Paint tank pressure too low • Old paint (viscosity too high) • Loose paint gun tip and/or shroud • Insufficient heat • No shroud 	<ul style="list-style-type: none"> • Poor appearance • Line has fuzzy edges • Slow drying time • Paint won't flow smoothly 	<ul style="list-style-type: none"> • Increase atomizing air pressure • Increase material tank pressure • Rotate material stock • Secure paint gun tip and/or shroud • Increase heat (enough to get paint to flow evenly) • Install shroud

Figure 3.1

VIRGINIA DOT REFERENCES

See Appendix A for the following:

VIRGINIA DOT ROAD & BRIDGE SPECIFICATIONS BOOK

Section 246.01 thru 246.02 (a) and (b)

- (a) Color Requirements
- (b) NTPEP Test Deck Qualification Requirements

Section 246.02 (g) 3. a and c

(g) Construction Pavement Marking Material

- 3. Temporary Marking Material
 - a. Paint Products
 - c. All Products (Requirements as a Temp. Marking)

Section 704.01 thru 704.03 (a) 1.

704.01 thru 704.03 Description, Material Types, and Procedures

- (a) Pavement Markings
 - 1. Type A Markings

See Appendix B for the following:

VIRGINIA DOT MANUAL OF INSTRUCTIONS

Section 204.30 (a) (1) and (2)

- (1) Sampling, Testing, and Approval
- (2) Acceptance (Requires Cert. I)

Approved List # 20

See Appendix C for the following:

VIRGINIA TEST METHOD

VTM-94 Quality Control Testing of Pavement Markings

Chapter 3
Traffic Paint
Review Questions

1. VDOT designated “Type A” traffic paint should dry “track-free within:
 - a) 5 minutes
 - b) 2 minutes
 - c) 60 seconds
 - d) 30 seconds

2. Reflective beads are normally:
 - a) added to the paint before it is applied to the roadway.
 - b) spray applied to the wet paint immediately following application of the marking material.
 - c) hand tossed into the marking.
 - d) applied after the marking has dried.

3. The minimum surface temperature at which Virginia designated Type A traffic paint may be applied is:
 - a) 30 °F +
 - b) 45 °F +
 - c) 50 °F +
 - d) 60 °F +

4. Before marking materials of any kind may be applied, the surface of the roadway must be:
 - a) clean.
 - b) dry.
 - c) both a & b
 - d) none of the above

5. The specified application thickness for Virginia designated Type A traffic paint is:
 - a) 90 ±5 mils when set
 - b) 20 ±2 mil when wet
 - c) 15 ±1 mil when wet
 - d) 12 ±3 mil when wet

6. The minimum amount of glass beads to be applied to Type A paint is:
 - a) 6 pounds per gallon
 - b) 25 pounds per gallon
 - c) dependant on bead gradation
 - d) dependant on environmental conditions