Performance Test: Pavement Marking Materials

ROBERT A. BURCH, Traffic Engineer,
North Carolina State Highway Commission

● NOT UNLIKE many other governmental agencies, for many years the North Carolina State Highway Commission purchased pavement marking materials on the basis of formulation specification and lowest cost per gallon.

Most every state-highway department feels it has the best formula, yet there is considerable variation in durability and performance shown by the materials purchased under each of these many specifications. More alarming is the fact that materials purchased under the same specification vary tremendously from year to year.

You have probably heard a state-highway maintenance engineer or a traffic engineer say, "I hope that X Company is not the low bidder this year - their paint didn't last worth a darn last year," or "I hope Y Company is low this year, they delivered a wonderfully durable material the year before last."

This pavement-marking situation is even more serious - it is one of the things that go toward making up the "show case" of the street or highway system. The traffic engineer or the maintenance engineer has been allocated or budgeted certain moneys to be spent for pavement-marking materials. Along comes the purchasing agent who makes an award on lowest price per gallon, spending the traffic or maintenance engineer's money and leaves him with the problem of how it performs.

If it doesn't wear well the traffic engineer or the maintenance engineer must make repeated applications (if weather permits) and be subjected to criticism, official and otherwise, and be unhappy with a line or marking of low average quality.

Therefore, it appears that the problem could be boiled down to a few pertinent factors: (1) Is the material the desired color and does it hold that color? (2) Does the material handle well? Is it easily mixed? Is its shelf life good? Does it apply well? Does it have reasonable drying time? (3) Is it durable? Does it perform?

Now we have said, in effect, we don't care how you make your material - but rather, How does it perform? We are not involved in designing a paint and thus being forced to "sleep in the bed we made." We are putting the burden on the manufacturer to produce a durable, well-performing material for the lowest cost. Thus we leave open the door for research, progress and ingenuity.

So, the question before us now appears to be: What kind of yardstick can we use to determine performance?

PURPOSE

The purpose is to explore the possibility of finding a method to make awards for pavement marking materials on a performance basis.

OBJECTIVE

It is intended to apply pavement marking materials supplied by the vendors to a heavy traffic volume highway. These markings to be applied transversely in order to get accelerated wear and shorten required time of test.

It is anticipated that this test will provide a numerical value of relative performance which can be used as a basis of award with much more accuracy as to the true value of the material than its chemical composition and price per gallon.

MATERIALS

All the material tested was of the premixed reflectorized type. Previous tests repeated over a period of several years rather conclusively revealed that the premixed material gave better over-all performance. Also, the use of premixed material simplified application and elim-

inated the necessity for additional gadgets on an already complicated machine.

The material was not identified in any way that would disclose composition.

APPLICATION OF MATERIALS

It was decided to apply the test by the same general method of marking currently used by the highway commission, namely, an air-pressure spray-gun arrangement.

All materials were applied on the same day with weather conditions being substantially the same for all.

Realizing that it would be a laborious and tedious job to attempt to apply all materials at exactly the same film thickness, it was decided to load the machine with a 1-gal. sample of a given material, adjust the pressure, etc. to obtain a line as close to the desired uniformity and thickness as visually possible - then to apply the transverse lines across the pavement. The material remaining in the tank was run out longitudinally at the same pressure as was used on the transverse lines. The length of longitudinal line was measured and added to the combined length of the transverse line to give the figure of footage covered per gallon of material.

It is realized that others have used methods approximating laboratory control in the making of "field" tests, and I say "field" advisedly. However, it is open to question whether it is realistic to make field tests with a degree of fineness which can never be achieved in the practical every day use of the material. That is the proving ground where the reckoning of the money spent for it takes place.

RATING OF PERFORMANCE

The method of rating the materials is the nationally known system, as follows:

10	Perfect or absence of failure
9, 8, 7	Good or slight failure
6, 5, 4	Fair or intermediate failure
3, 2, 1	Poor or bad failure
0	Very poor, or poorest degree conceivable, or complete failure.

These ratings were applied to the factors or general appearance, color, and film condition. Numerical photometric readings converted to a scale of 0 to 10 were used for reflection.

The ratings for general appearance, color, and film condition were obtained by periodic visual inspections.

Ratings were made by graduate students and instructors at North Carolina State College who had no knowledge of the identity of the materials.

When a line reached a rating of "3" in any one of the above factors it was considered to have terminated its useful life.

ANALYSIS, EVALUATION AND APPLICATION OF PERFORMANCE RATINGS

It is intended to determine the cost per foot per day of useful life for each material. To do this it is necessary to add to the cost per gallon of each material the application cost per gallon and divide it by the number of days of useful life and the footage per gallon for each material:

$$\text{Cost per foot per day of useful life} = \frac{\dfrac{\text{cost of material per gal.}}{\text{days of useful life}} + \dfrac{\text{cost of application per gal.}}{\text{footage covered}}}{}$$

Up to this point we seem to be getting along fine, that is if we wait for each material to wear out (to reach a rating of "3").

If it had been necessary to wait until each line reached a rating of "3", the test would have lost its usefulness as a tool to aid in the purchasing of materials in the early spring in order to be ready to start marking as soon as weather permits.

Therefore, it was necessary to employ a means of extrapolating to determine the expected remaining life of those lines which had not terminated their useful life.

To do this we have assumed: (1) a perfect line has a rating of 10; (2) a line needs replacement when it has a rating of "3"; and (3) within practical limits the depreciation of a line from a rating of "10" to a rating of "3" is a straight-line proportion.

Therefore, we say,

$$\text{Cost per foot per day of useful life} = \frac{\text{cost of material per gal.}}{\text{days of test} \times \frac{R_p - R_r}{R_p - R_n} \times \text{footage per gal.}} + \frac{\text{cost of application per gal.}}{\text{days of test} \times \frac{R_p - R_r}{R_p - R_n} \times \text{footage per gal.}}$$

When

$R_p = 10$, perfect rating

$R_r = 3$, replacement rating

$R_n =$ rating now

Thus we arrive at a numerical value of cost. The material showing the lowest cost in these terms is the material purchased.

CONCLUSION

It is practical to make awards for the purchase of pavement marking materials on the basis of performance. Additional study and research is needed to develop a more convenient practical field method for evaluating the performance and characteristics of material.

RECOMMENDATIONS

1. The development of a reasonably priced, sturdy, direct-reading photometer.
2. The development of a special test striper. Particular consideration should be given to: light weight, more-rapid method of tank cleaning, more-practical and faster handling of small quantities of pavement marking materials generally used in testing.
3. That all tests be applied in early spring to allow for longer evaluation period.